Marinette County
Lower Peshtigo River Watershed
Management Plan

2015

Marinette County Land Information Committee

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Lower Peshtigo River Watershed Nine Key Element Plan

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Acronyms and Definitions

Invasive Species and Aquatic Invasive Species (AIS) are plants or animals not native to a specific location (an introduced species); and have a tendency to spread, which is believed to cause damage to the environment, human economy and/or human health

Best Management Practices – BMP's

Department of Agriculture, Trade, and Consumer Protection (Wisconsin)- DATCP

Land & Water Conservation Division of the Marinette County Land Information Department (LWCD) provides primary authorship of this plan. Its program areas include nonpoint source pollution, invasive species, environmental education, water quality, and wildlife habitat.

Environmental Quality Incentives Program (EQIP) is a voluntary program offered by the NRCS that provides financial and technical assistance to agricultural producers through contracts up to a maximum term of ten years in length. These contracts provide financial assistance to help plan and implement conservation practices that address natural resource concerns and for opportunities to improve soil, water, plant, animal, air and related resources on agricultural land and non-industrial private forestland.

Erosion Vulnerability Assessment for Agricultural Lands (EVAAL) assists watershed managers in prioritizing areas within a watershed which may be vulnerable to water erosion (and thus increased nutrient export) and thus may contribute to downstream surface water quality problems. It evaluates locations of relative vulnerability to sheet, rill and gully erosion using information about topography, soils, rainfall and land cover. This tool enables watershed managers to prioritize and focus field-scale data collection efforts, thus saving time and money while increasing the probability of locating fields with high sediment and nutrient export for implementation of best management practices (BMPs).

Full Time Employee – FTE

Harmony Arboretum is 460 acre property administered by the LWCD. Centrally located in the watershed, nine miles west of Marinette, the property is also used by the Marinette County UW-Extension and the Northern Lights Master Gardeners to deliver education programs. The arboretum contains a pavilion for hosting events, a large horticultural demonstration area, children's learning garden, exhibits, and hiking and interpretive trails.

Healthy Watershed Assessment (HWA) is model-based assessment tool for all the watersheds in Wisconsin. This tool ranks each watershed based on many aspects of watershed condition, including water quality, hydrology, habitat, and biological condition. The assessment results are a **modeled prediction** of both overall watershed health and vulnerability, which are presented in a series of maps and ranking scores.

Hydrologic Unit Code (HUC) is a series of two-digit groupings of numbers that describe a hydrologic unit's scale, plus where it fits in the larger hydrologic unit framework. This creates dataset comprised of nested regions. Hydrologic units range in size from regions, which can cover several states, to subwatersheds, which generally cover areas of 25 to 50 square miles. HUCs start with a two-digit code for the region level, and then additional two-digit codes are appended as one moves in to smaller watersheds. The subwatershed level contains a 12-digit HUC.

Index of Biotic Integrity (IBI)

Land and Water Resources Management (DATCP) – LWRM

Lower Peshtigo River watershed – LPR

Light and radar (LiDAR) is a remote sensing technology that measures distance by illuminating a target with a laser and analyzing the reflected light to create a very accurate digital model or 3D representation of a terrain's surface. The generated data is incorporated into EVAAL.

Municipal Separate Storm Sewer System (MS4) WPDES program. MS4 municipalities must, to the maximum extent practicable, implement a reduction in total suspended solids in runoff that enters waters of the state as compared to no controls.

Natural Resources Conservation Service (Federal) – NRCS

Non-governmental Organizations – NGO's

Northwoods Journal (NWJ) is a free newspaper distributed across Marinette County by the Marinette County Land Information Department – Land and Water Conservation Division. Each edition of approximately 5,000 papers is put out for June, July, August, and September. The papers publicize local conservation efforts and issues, promote environmentally friendly behavior, and provide general knowledge about the natural world.

SnapPlus (**S**oil **n**utrient **a**pplication **p**lanner) is Wisconsin's nutrient management planning software. The program helps farmers make the best use of their on-farm nutrients, as well as make informed and justified commercial fertilizer purchases. By calculating potential soil and phosphorus runoff losses on a field-by-field basis while assisting in the economic planning of manure and fertilizer applications, SnapPlus provides Wisconsin farmers with a tool for protecting soil and water quality.

Spreadsheet Tool for Estimating Pollutant Load (STEPL) employs simple algorithms to calculate nutrient and sediment loads from different land uses and the load reductions that would result from the implementation of various best management practices (BMPs). STEPL provides a user-friendly Visual Basic (VB) interface to create a customized spreadsheet-based model in Microsoft (MS) Excel. It computes watershed surface runoff; nutrient loads, including nitrogen, phosphorus, and 5-day biological oxygen demand (BOD5); and sediment delivery based on various land uses and management practices. For each watershed, the annual nutrient loading is calculated based on the runoff volume and the pollutant concentrations in the runoff water as influenced by factors such as the land use distribution and management practices. The annual sediment load (sheet and rill erosion only) is calculated based on the Universal Soil Loss Equation (USLE) and the sediment delivery ratio. The sediment and pollutant load reductions that result from the implementation of BMPs are computed using known BMP efficiencies.

Targeted Runoff Management Program (WDNR) – TRM **Small-scale non-TMDL projects**
Only agricultural projects implementing state agricultural performance standards and prohibitions are eligible. They may be in any area to protect or restore surface water or groundwater. Projects run 2-3 years in duration. Grants are limited to $150,000.

Large-scale non-TMDL projects
Only agricultural projects implementing state agricultural performance standards and prohibitions are

eligible. They may be in any area to protect or restore surface water or groundwater. However, the project area may not be less than 8 or more than 39 square miles. Eligible costs include construction of structural best management practices, implementation of non-structural cropping practices and some staffing costs to plan and install management practices. Projects run 3-4 years in duration. Typical grants are approximately $500,000 to $1 million.

Teaching Outdoor Awareness & Discover Program (TOAD) is a trailered collection of field and monitoring equipment designed to provide experiential environmental education programs at no charge across Marinette County. TOAD provides aquatic and terrestrial programs based on the needs of educators, group leaders, etc.

University of Wisconsin Extension (Marinette County) – UWEX

Wild Rivers Invasive Species Coalition (WRISC) is a cooperative invasive species partnership operating in northeast Wisconsin and the Upper Peninsula of Michigan. The partnership consists of a wide range of partners and members from local, state, tribal, and federal agencies, land managers, utility companies, civic organizations, businesses, and individuals, all interested in the education and management of invasive species.

Wisconsin Department of Natural Resources – WDNR

Wisconsin Land and Water (WLW) is a 501(c)3 non-profit, is a membership organization supporting the efforts of 450 Land Conservation Committee (LCC) supervisors and 350 conservation staff in 72 county Land Conservation Department (LCD) offices through training, conservation standards development, youth education, grants, partnership building, and advocacy.

Chapter 1. Introduction

The 195 square mile Lower Peshtigo River Watershed is located in southeastern Marinette County. The Watershed is diverse for its size. And, unlike many river drainages, the least developed portion is at the mouth where the Peshtigo River enters Green Bay. At the end of the 19th century the river mouth was the site of thriving community that served the logging industry in the region. Now the river mouth is encompassed by the 1000's of acres of undeveloped forest and wetland owned by the State of Wisconsin.

Almost immediately upstream of the State land is the City of Peshtigo, Marinette County's second largest City. Upstream from Peshtigo, the land use is almost evenly split between agriculture and recreational/rural residential. See Map 2-1 for a list of land uses in the watershed.

Plan development process

Build Partnerships

This plan builds on the Marinette County 2011-2020 Land & Water Resources Management (LWRM) Plan and its development process. Many of the partnerships and relationships developed during the creation of the LWRM plan, and its implementation, have been utilized in the development of the Lower Peshtigo River Watershed Management Plan. Wisconsin Department of Natural Resources (WDNR), and Natural Resources Conservation Service staff are providing assistance and guidance in the development of this plan. Marinette County has been actively working in the watershed, primarily through the WDNR's Targeted Runoff Management and Aquatic Invasive Species programs. Many of relationships, with agricultural producers, external agencies, and local units of government, are already built. Much of the outreach has already been conducted.

Characterize the Watershed

A significant challenge in the development of this plan has been the paucity of water quality and land use information. Most of water quality data available for the watershed was from the WDNR's Upper Green Bay Basin Integrated Management Plan. Unfortunately, the average age of the studies referenced in that document is now 29 years old. The most recent land use data available was from 2001.

In 2014, water samples were taken, and aquatic insects gathered, from nine stream sites across the watershed. An additional nine sites were chosen for 2015 and monitored for the same parameters. Unfortunately, at the time of this writing, only Phosphorus is available for analysis. When the aquatic insect data becomes available it will be incorporated into and used to revise the plan.

In 2005, Marinette County staff conducted a windshield survey of county farms. A Marinette County staff person stopped adjacent to every farm visible from road sides and recorded data on multiple parameters. In 2015 recent, high definition aerial photography was used to partially recreate the survey. The results of these two efforts are discussed in detail in Chapter 3.

The STEPL model was applied to the watershed as part of the plan development process to estimate initial pre and post project nutrient and sediment loads from agricultural operations. With additional data gathering, the STEPL data inputs (cropland area, feedlots area, beef and dairy cattle numbers) will be updated and modified- see the Implement Watershed Plan section below

Finalize Goals and Identify Solutions
At the County level, the main nonpoint source pollution goals were set in 1998 with the first Targeted Runoff Management grant project. Marinette County goals are discussed in detail in chapter 5.

More recently, additional goals were set through involvement with the NRCS Local Work Group. NRCS holds and annual meeting where stakeholders from Marinette, Menominee, Oconto, and Shawano counties provide recommendations on local natural resource priorities and criteria for USDA conservation activities and programs. Local work group responsibilities include:

- Develop a conservation needs assessment identifying broad conservation goals to solve natural resource issues;
- Identify priority resource concerns that can be addressed by USDA programs;
- Recommend USDA conservation program application and funding criteria, eligible practices (including limits on practice payments or units), and payment rates;
- Assist NRCS and the conservation district with public outreach and information efforts;
- Identify educational and producers' training needs; and,
- Recommend program policy to the State Technical Advisory Committee based on resource data.

The five Priority Resource Concerns of the Local Work Group for 2016 are:

1. Water Quality Degradation
2. Soil Erosion
3. Soil Quality Degradation
4. Fish and Wildlife – Inadequate Habitat
5. Degraded Plant Conditions

There is significant overlap between these goals, the goals of the Marinette County

Land and Water Resources Management Plan, and the goals of the Lower Peshtigo River Watershed Implementation Plan.

Design an Implementation Program

The limiting factors for implementation have been, and continue to be, cost sharing for practices and staffing resources at the local, state, and federal level. The implementation schedule and resultant progress measures are almost entirely dependent upon the amount of cost sharing and staff time available. These constraints at all levels have limited the amount of monitoring and evaluation completed, not just in the Lower Peshtigo River Watershed, but in all of Marinette County.

As stated above, some monitoring has been completed. However, a great deal more needs to be done to understand current water quality and biotic conditions and to evaluate conditions over time. A number of monitoring and evaluation needs were discovered during the writing of this plan. They are discussed in Chapter 5.

Implement Watershed Plan

A great deal of completed work predates this plan, especially installation of constructed Best Management Practices (BMP's). Work in the watershed has already begun to evolve. Efforts are shifting from predominantly hard BMP installations to maintaining compliance with Operation and Maintenance requirements, implementation of nutrient management plans, and farm abandonments. With these realities in mind, a number of monitoring and evaluation strategies are recommended in Chapter 9.

Plan revision will be a key component of implementation as the water quality and biotic data gathered in 2014 and 2015 are analyzed and integrated. At the time of this writing several data sets are not complete due to the lag time between data gathering and analysis. Additionally, Marinette County has received LiDAR data that will facilitate the use of the EVAAL toolset to prioritize areas vulnerable to water erosion and thus increased nutrient export. The Healthy Watershed Assessment, described in detail in Chapter 2, is also incorporated into this plan.

Measure Progress and Make Adjustments

A great deal of progress has already been made in the watershed, as described in chapter 4. As the analysis of monitoring data and modeling tools such as the Healthy Watershed Assessment and EVAAL tools gain greater usage, targeting of conservation efforts on the land will change. Additionally, as the number of active commercial farm operations decrease, the types of best management practices utilized will evolve. New technologies, regulations, and funding sources will also push or pull implementation activities in new directions. The SNAP+ model will be used in the Trout Creek subwatershed using known crop rotations, soil types, and soil P concentrations. Trout Creek is the most heavily farmed subwatershed and will serve as a surrogate to determine the efficacy of installed practices and measure progress. All these factors will be used to make adjustments/amendments to this watershed plan over time.

Plan requirements

In 1987, Congress enacted the Section 319 of the Clean Water Act which established a national program to control nonpoint sources of water pollution. Watershed plans funded by Clean Water Act section 319 funds must be consistent with the nine key elements the EPA has identified as critical for achieving improvements in water quality (USEPA 2008). The nine elements from the USEPA Nonpoint Source Program and Grants Guidelines for States and Territories are as follows:

1. Identification of causes of impairment and pollutant sources or groups of similar sources that need to be controlled to achieve needed load reductions, and any other goals identified in the watershed plan. Sources that need to be controlled should be identified at the significant subcategory level along with estimates of the extent to which they are present in the watershed.

2. An estimate of the load reductions expected from management measures.

3. A description of the nonpoint source management measures needed for implementation to achieve load reductions in element 2, and a description of the critical areas in which those measures will be needed to implement this plan.

4. Estimate of the amounts of technical and financial assistance needed, associated costs, and/or the sources and authorities that will be relied upon to implement this plan.

5. An information and education component used to enhance public understanding of the plan and encourage their early and continued participation in selecting, designing, and implementing the needed nonpoint source management measures.

6. A reasonably expeditious schedule for implementing the nonpoint source management measures identified in this plan.

7. A description of interim measurable milestones for determining whether nonpoint source management measures or other control actions are being implemented.

8. A set of criteria that can be used to determine whether loading reductions are being achieved over time and substantial progress is being made toward attaining water quality standards.

9. A monitoring component to evaluate the effectiveness of the implementation efforts over time, measured against the criteria established under element 8.

Performance standards and prohibitions

Wisconsin statutes require the Department of Natural Resources and the Department of Agriculture, Trade, and Consumer Protection to develop performance standards for agricultural and non-agricultural nonpoint pollution sources. The agricultural performance standards and prohibitions in Figure 1-1 will be the authority(s) relied upon to identify and select best management practices and implement the pollutant reductions identified within this watershed plan.

Figure 1-1. Overview of Agricultural Standards and Associated Conservation Practices

Performance standard (type of standard covered)	Effective Date	Conservation Practices
Sheet, rill, and wind erosion	October 1, 2002	Install contour buffer systems, crop rotation, conservation tillage, no-till planting, contour strip cropping, and contour farming. Related practices: grade stabilization structures, grassed waterways, critical area stabilization, and lined waterways.
Tillage setback	January 1, 2011	No tillage operations may be conducted within 5 feet of the top of channel of surface waters. Tillage setbacks greater than 5 feet but no more than 20 feet may be required.
Phosphorus index	July 1, 2012	Croplands, pastures and winter grazing areas shall average a phosphorus index of 6 or less over the accounting period and may not exceed 12 in any individual year of the accounting period
Manure storage facilities	October 1, 2002	Follow NRCS standards for construction, maintenance and closure using technical standards 313 (Waste storage facility), 360 (Closure of waste impoundments), 634 (Waste transfer system)
Process wastewater handling	January 1, 2011	Follow NRCS standards for construction, maintenance and closure using technical standards 629 (Waste Treatment),
Divert clean water from feedlots (Livestock facilities within Water Quality Management Areas)	October 1, 2002	Install roof runoff management systems, earthen diversion and underground outlets
Nutrient management	October 1, 2008	Develop and implement annual nutrient management plan for applying all nutrients in a manner compliant with standard 590 (Nutrient Management); Install conservation practices to reduce runoff and nutrient loading.
Manure Management Prohibitions a. No overflow from manure storage facilities. b. No unconfined manure stacks with Water Quality Management Areas. c. No direct runoff from feedlots and manure storage facilities to waters of the state. d. No unlimited access of livestock to shore lands that prevents maintenance of adequate sod cover. (Livestock facilities)	October 1, 2002	Design and construct facilities to technical standards, maintain existing facilities, repair or replace facilities, as needed. a. Relocate manure stacks to more environmentally safe areas. Construct storage facility. b. Install barnyard runoff control systems, roof runoff management systems, wastewater treatment strips, relocate animal feeding facilities. c. Install access roads and cattle crossings, watering facilities, livestock fencing, riparian buffers, prescribed grazing, stream bank protection.

Chapter 2. Characterizing the Lower Peshtigo River Watershed

Physical Setting

Before discussing the Lower Peshtigo River Watershed it is important to note the watershed boundary has radically changed. Two HUC 12 sub watersheds (Left Foot Creek and Peterman Brook) were removed. The Thomas Slough HUC 12 was added. The boundaries for the remaining original HUC12's were also altered. The two boundaries are compared in Figure 2-1.

The revision was not discovered until late in the planning process. All Marinette County farm and project data were based on the old watershed boundary. The WDNR water quality and biotic monitoring regimes for 2014 and 2015 were also based on the old boundary. This means we have gathered no data for the City of Marinette or the Thomas Slough HUC12, which is in Oconto County. Typically Marinette County staff do not work within City boundaries and cannot work in Oconto County to install or implement pollutant reduction practices.

Newer data sets and tools such as the Healthy Watershed Assessment tool, STEPL and EVAAL models for this plan use or, when complete will utilize the new watershed boundary shown in figure 2-1.

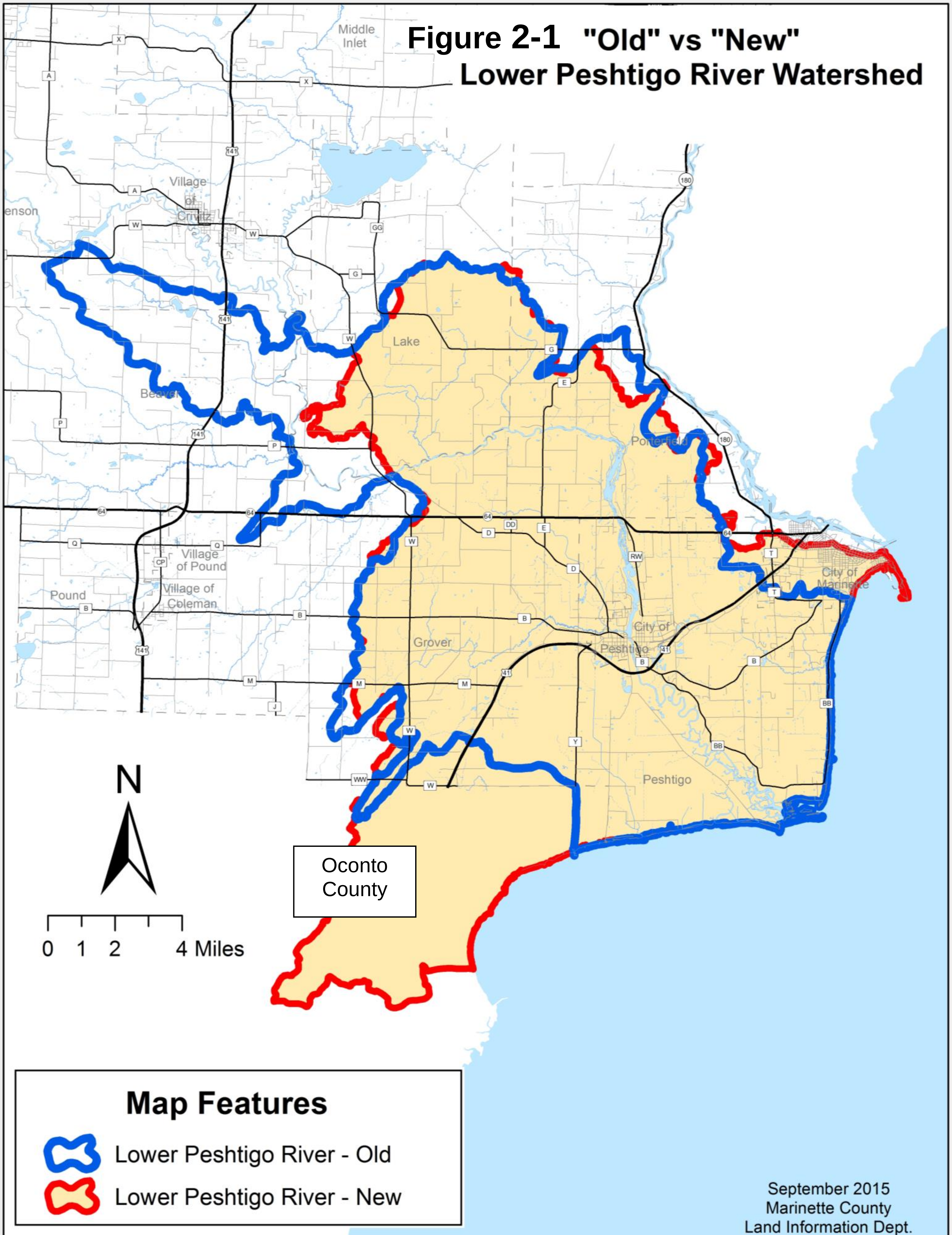


Figure 2-1 "Old" vs "New"
Lower Peshtigo River Watershed
Middle Inlet
Village of Crivitz
Lake
Beaver
Porterfield
Village of Pound
Pound
Village of Coleman
Grover
City of Peshtigo
City of Marinette
Peshtigo
Oconto County
N
0 1 2 4 Miles
Map Features
Lower Peshtigo River - Old
Lower Peshtigo River - New
September 2015
Marinette County
Land Information Dept.

The main source for physical setting in Marinette County is the Soil Survey of Marinette County, produced in 1991 by the Soil Conservation Service.

Climate and Precipitation

The frequency, duration and amount of precipitation influence surface and groundwater quality and quantity, soil moisture, runoff characteristics, and the physical condition of waterways. Marinette County lies in the continental zone that has long, cold, snowy winters and summers that are mostly warm with hot humid periods. Winter mean temperatures average 16 degrees Fahrenheit (F). Winter low temperatures average 5 degrees F. The average mean summer temperature is 66 degrees F, with an average high temperature of 79 degrees F. Mean annual precipitation for the region is about 32 inches. The majority of precipitation falls as rain during April through September. Most runoff occurs in February, March, and April when the land surface is frozen and soil moisture is highest.

Topography and Drainage

The physiography, relief, and drainage of the county are primarily the result of glaciation. Marinette County contains three major physiographic regions. The Northern Highlands Region is found in northwestern portion of the county. The central section of the county has the Wisconsin Central Plain. The Eastern Ridges and Lowlands region covers most of the Lower Peshtigo River Watershed. Watershed elevation drops approximately 150 feet from its northwest edge just west of Crivitz to the Peshtigo River mouth (584 ft.)

Soils

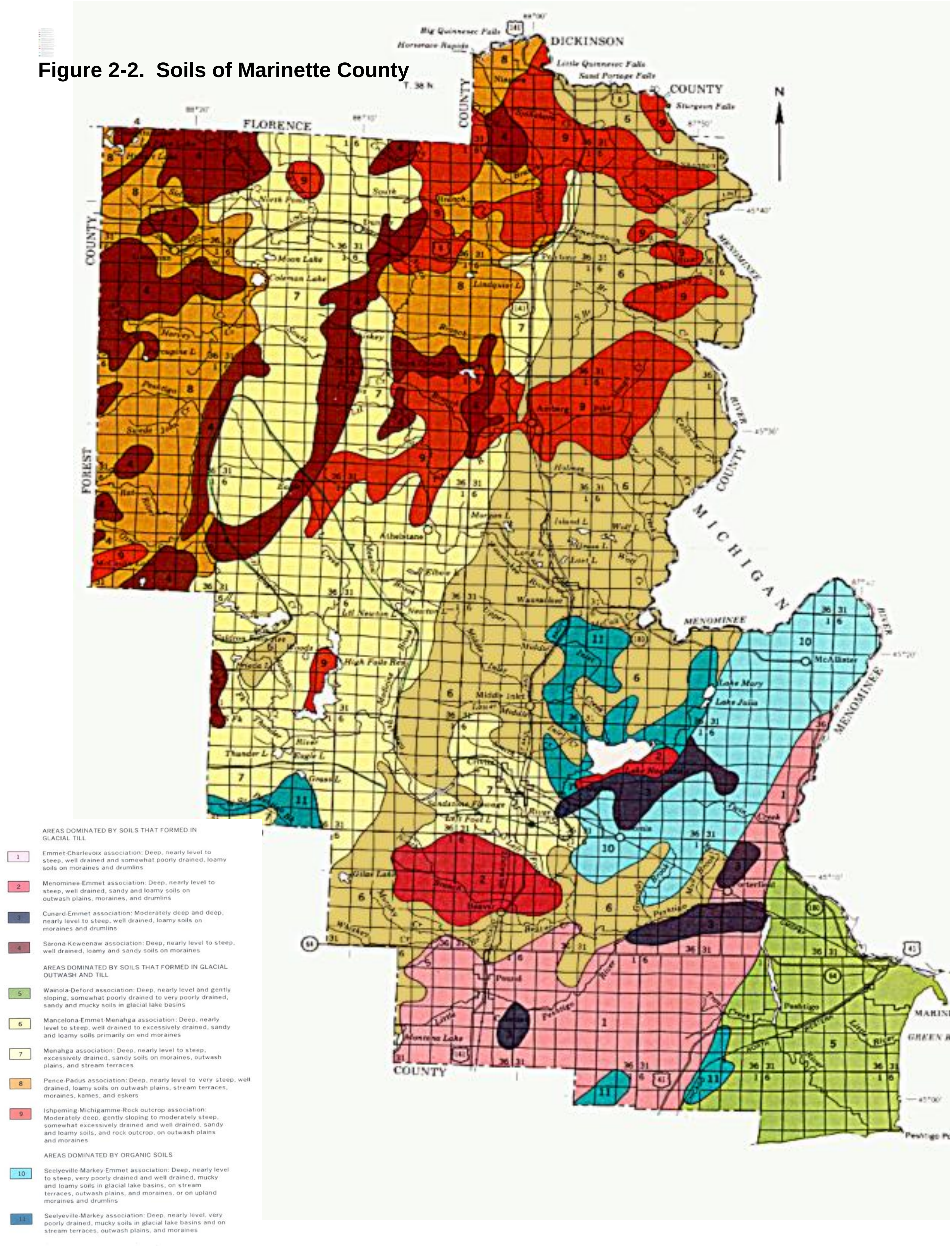
Marinette County has a rich and varied history of glacial geology. Glacial ice, part of the Continental Glaciation, covered all of Marinette County as recently as 10,000-12,000 years ago. The last glacial advance was marked by two distinct lobes that moved into the county. The Green Bay Lobe entered the county from the northeast, while the Langlade Lobe entered from the northwest. The edges of the furthest advance of these ice lobes are marked by end moraines and can be seen throughout the county. Many times these moraines are only a few miles apart, indicating there was considerable advance and retreat of the glacier due to climatic changes. Due to the many ice fluctuations, soil patterns are very complex in many county areas.

The soil associations in the Lower Peshtigo Watershed may be lumped into two groups, based on their glacial history. The major soil types of Marinette County are shown in Figure 2-2.

Soils formed in glacial outwash and till
Much of the Lower Peshtigo Watershed soils consist of the Wainola-Deford, Emmet-Charlevoix, and Mancelona-Emmet-Menahaga associations. These soils were formed on a complex topography of moraines, outwash plains, stream terraces, and glacial lake basins. Rapid permeability or moderate permeability, wetness and excessive slope are the main limitations on sanitary facilities. These soil associations underlay the fastest growing areas of the county, in terms of recreational use, population growth and new construction. They are also among the most susceptible to ground water contamination.

Organic soils
Organic soils make up a small portion of the watershed. The Seelyeville-Markey-Emmet and Seelyeville-Markey associations make up this group. The soils in this group were formed in glacial lake basins, on outwash plains, stream terraces, moraines, and drumlins. Most areas of this group are best suited for woodland or wildlife. Wetness and low strength are the main limitations in managing these soils as woodland, cropland, or pasture. These same limitations affect building site and recreational development, and sanitary facilities.

Figure 2-2. Soils of Marinette County



Water Resources

The Peshtigo River watershed is part of the Upper Green Bay Basin. The Upper Green Bay Basin consists of 18 watersheds in northeastern Wisconsin. Major river systems include the Menominee, Peshtigo, Oconto, Pensaukee, Suamico, and Little Suamico.

The Peshtigo River flows 136 miles from its headwaters in northwest Forest County to its mouth. North and west of Caldron Falls Flowage, (the northern most impoundment) the Peshtigo flows through largely undeveloped forest land. This stretch of river is regionally known for white water rafting. Downstream from Caldron Falls are another five flowages formed by hydro-electric dams.

The last twenty-six miles of the Peshtigo River flow through the Lower Peshtigo River watershed before draining into Green Bay. Potato Rapids and Peshtigo Flowages are in this watershed. The Peshtigo River is fed by seven tributary streams. Although there are no natural lakes in the watershed, the generally high water table makes small manmade ponds common.

Watershed Assessment

This section utilizes the Wisconsin Integrated Assessment of Watershed Health (http://dnr.wi.gov/topic/watersheds/hwa.html) to characterize the Lower Peshtigo River watershed, its constituent HUC12 sub watersheds and the smaller catchments within them relative to watershed health across the state to guide future protection initiatives. A healthy watershed has the structure and function in place to support healthy aquatic ecosystems. It generally has all or most of these key components: intact and functioning headwaters, wetlands, floodplains, riparian corridors, biotic refugia, instream and lake habitat, and biotic communities; and natural vegetation in the landscape, hydrology (e.g., range of instream flows and lake levels), sediment transport and fluvial geomorphology, and disturbance regimes expected for its location. For the Wisconsin Integrated Assessment, metrics are broadly grouped as:

- **Landscape condition** is described by the extent and connectivity of natural land cover throughout a watershed and within key functional zones such as floodplains, riparian areas, and wetlands.

- **Aquatic ecosystem health** refers to several properties of streams, lakes, and wetlands that describe their structure and function. The Aquatic Ecosystem Health score is based on several metrics representing habitat quality, hydrology, biological quality, and water quality.

- **Aquatic invasive species** metrics characterize the potential for altered aquatic communities due to the establishment of non-native species with aggressive growth habits and other traits that drive a shift from natural ecosystem conditions.

- **Watershed vulnerability** is defined as the potential for future degradation of watershed processes and aquatic ecosystem health. The Watershed Vulnerability score is based on several metrics representing projected land use change, projected climate change, and water use.

Figure 2-3 shows rank normalized metric scores range from 0 to 100 and are directionally aligned so higher scores correspond to higher LANDSCAPE CONDITION, AQUATIC ECOSYSTEM HEALTH, AQUATIC INVASIVE SPECIES PREVALENCE, OR WATERSHED VULNERABILITY.

Figure 2-3 Healthy Watershed Assessment Metrics

Metric Category	Metric Name	Directionality
Landscape Condition	Percent Natural Land Cover Percent Intact Active River Area Percent Wetlands Remaining Percent Hubs & Corridors	Higher Value = Higher Landscape Condition
Aquatic Ecosystem Health	Stream Patch Size Stream Habitat Rating Lake Clarity Macroinvertebrate IBI Score	Higher Value = Higher Aquatic Ecosystem Health
	Streamflow Ecochange Canal/Ditch Density Road Crossing Density Reed Canary Grass Dominated Wetlands Stream Nitrate-Nitrite Concentration Stream Total Phosphorus Concentration Stream Suspended Sediment Concentration	Higher Value = Lower Aquatic Ecosystem Health
Aquatic Invasive Species	Presence of Eurasian Watermilfoil Presence of Curly Leaf Pondweed Presence of Spiny Waterflea Presence of Zebra Mussel	0 = Absence 1 = Presence
Watershed Vulnerability	Projected Absolute Change in Surface Runoff Projected Change in Total Nitrogen Yield Projected Change in Total Phosphorus Yield Projected Change in Total Suspended Solids Yield Projected Change in Anthropogenic Land Cover Groundwater Dependency Index Groundwater Withdrawal Volume	Higher Value = Higher Watershed Vulnerability

This portion of the assessment tool ranks catchments in comparison to one another, using modeled Aquatic Ecosystem Condition and Vulnerability data. Each catchment in the state is ranked on a scale of 1 to 100. A score of 1 indicates lower biological health or lower vulnerability, respectively, and a score of 100 indicates higher biological health or higher vulnerability. In the following two maps below, each of the catchments in the Lower Peshtigo River watershed was graphed according to its health and vulnerability scores. The catchments are grouped and color-coded by the HUC 12 watershed they fall within, as denoted by the symbols in the legend. This analysis may be used to help prioritize implementation of practices described in this plan.

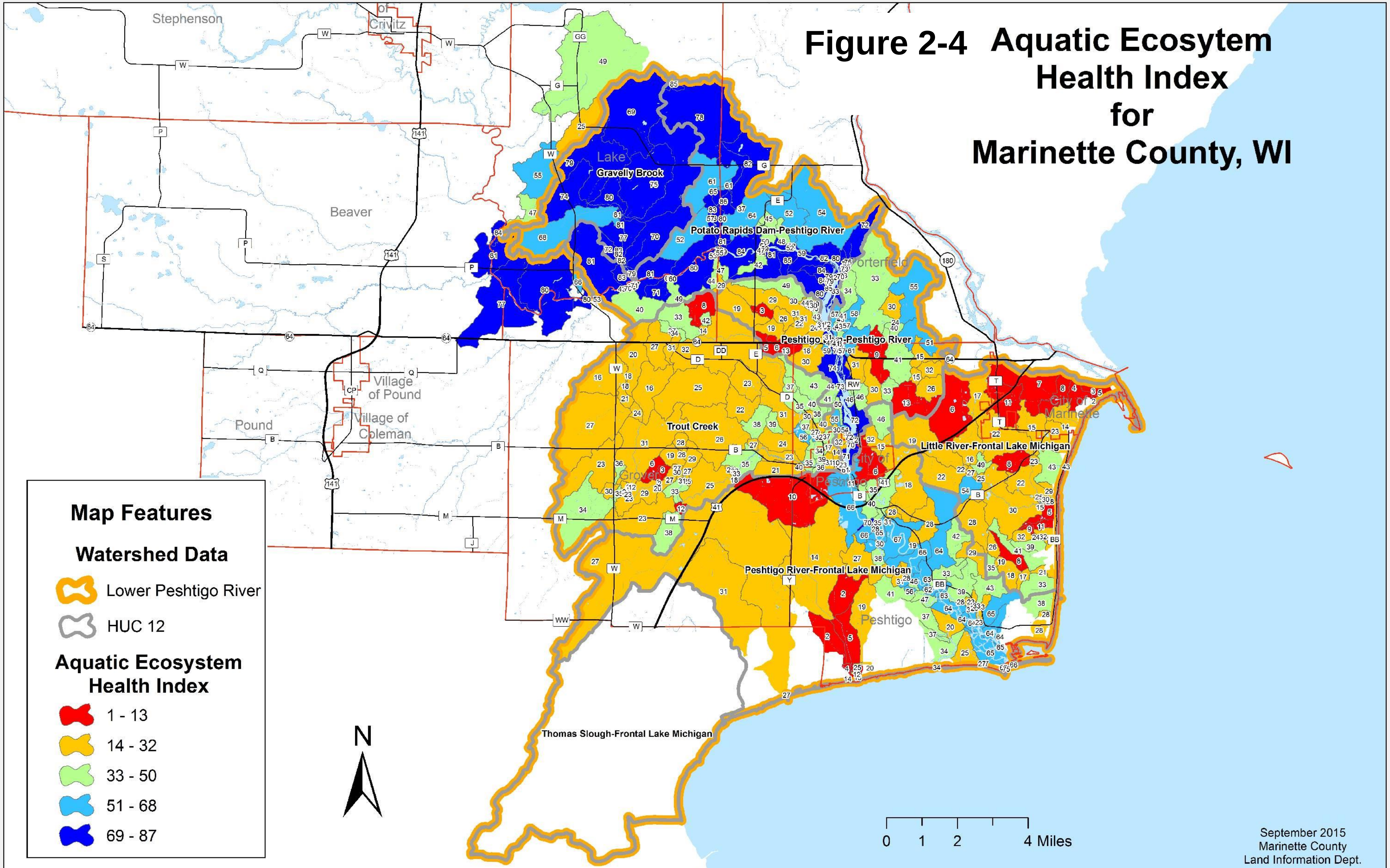


Figure 2-4 Aquatic Ecosytem Health Index for Marinette County, WI
Map Features
Watershed Data
Lower Peshtigo River
HUC 12
Aquatic Ecosystem Health Index
1 - 13
14 - 32
33 - 50
51 - 68
69 - 87
N
0 1 2 4 Miles
Gravelly Brook
Potato Rapids Dam-Peshtigo River
Peshtigo Dam-Peshtigo River
Trout Creek
Little River-Frontal Lake Michigan
Peshtigo River-Frontal Lake Michigan
Thomas Slough-Frontal Lake Michigan
Stephenson
Beaver
Pound
Village of Pound
Village of Coleman
Peshtigo
City of Marinette
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Marinette County
Land Information Dept.

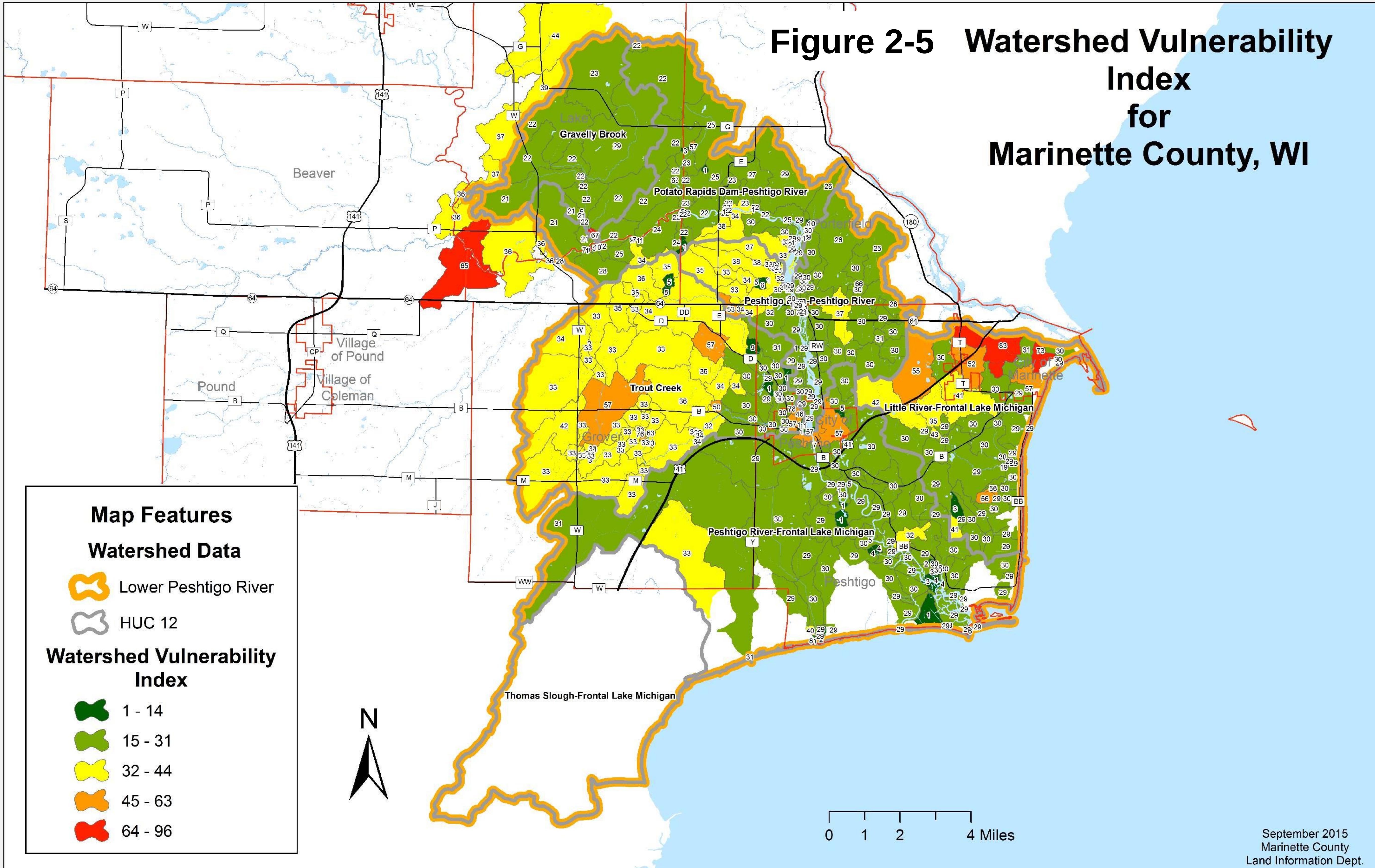
Figure 2-5 Watershed Vulnerability Index for Marinette County, WI
Gravelly Brook
Potato Rapids Dam-Peshtigo River
Peshtigo Dam-Peshtigo River
Trout Creek
Little River-Frontal Lake Michigan
Peshtigo River-Frontal Lake Michigan
Thomas Slough-Frontal Lake Michigan
Beaver
Village of Pound
Village of Coleman
Pound
Peshtigo
Marinette
Map Features
Watershed Data
Lower Peshtigo River
HUC 12
Watershed Vulnerability Index
1 - 14
15 - 31
32 - 44
45 - 63
64 - 96
N
0 1 2 4 Miles
September 2015
Marinette County
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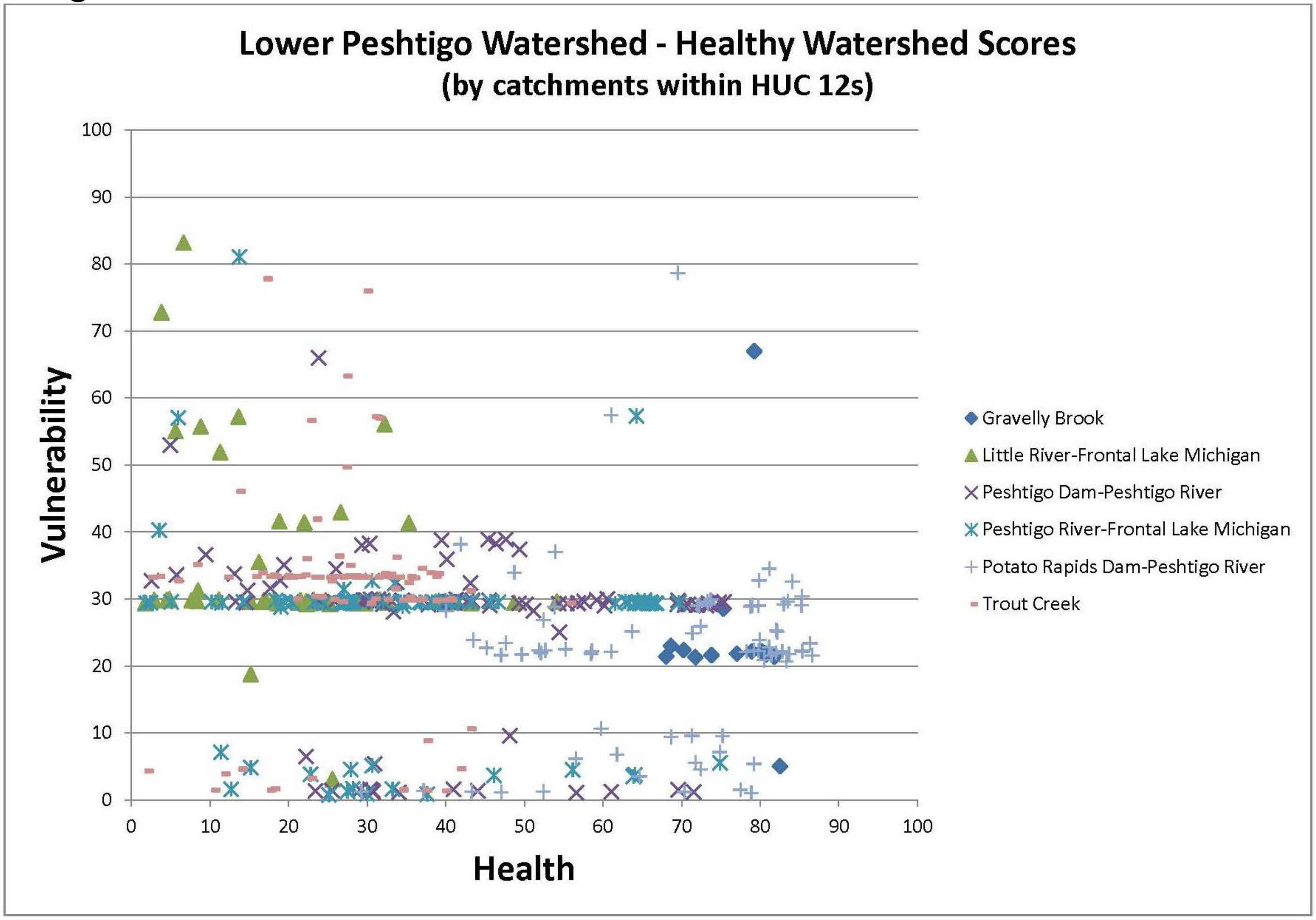
Figure 2-6



- Catchments in the upper right portion of the graph have high health scores but may also be most vulnerable to future degradation. These are areas which the county may wish to target protection efforts, to maintain high quality into the future.

- Catchments in the upper left quadrant of the graph have lower health scores and may also be vulnerable to future degradation. These areas may be the more difficult to make lasting improvements in. These include catchments from the Little River-Frontal Lake Michigan and Trout Creek watersheds. However, the Trout Creek watershed is the most intensely farmed watershed and an important contributor to the Peshtigo flowage in the City of Peshtigo. Additional investigation is required, and underway, to locate the unresolved nonpoint source pollution issues.

- Catchments in the lower left quadrant of the graph have lower health scores but may not be very vulnerable to future degradation. This may indicate that restorations made to these catchments might have better chances for lasting success. These include catchments in the Peshtigo River-Frontal Lake Michigan, Peshtigo Dam – Peshtigo River and Trout Creek.

- The remaining catchments in the lower right quadrant are higher in health and low in vulnerability. These areas may need little intervention to remain healthy in perpetuity, unless specific local impacts are known that the county wishes to address.

- A large number of catchments, across several HUC 12's are have vulnerability scores of 30. Additional investigation is required to determine why.

- The HWA tool does not take land ownership into consideration when ranking vulnerability. Figure 2-7 shows watershed land in public ownership. The Peshtigo Harbor Wildlife Area has catchments with somewhat elevated Vulnerability scores, but as public land it is at minimum risk of further degradation.

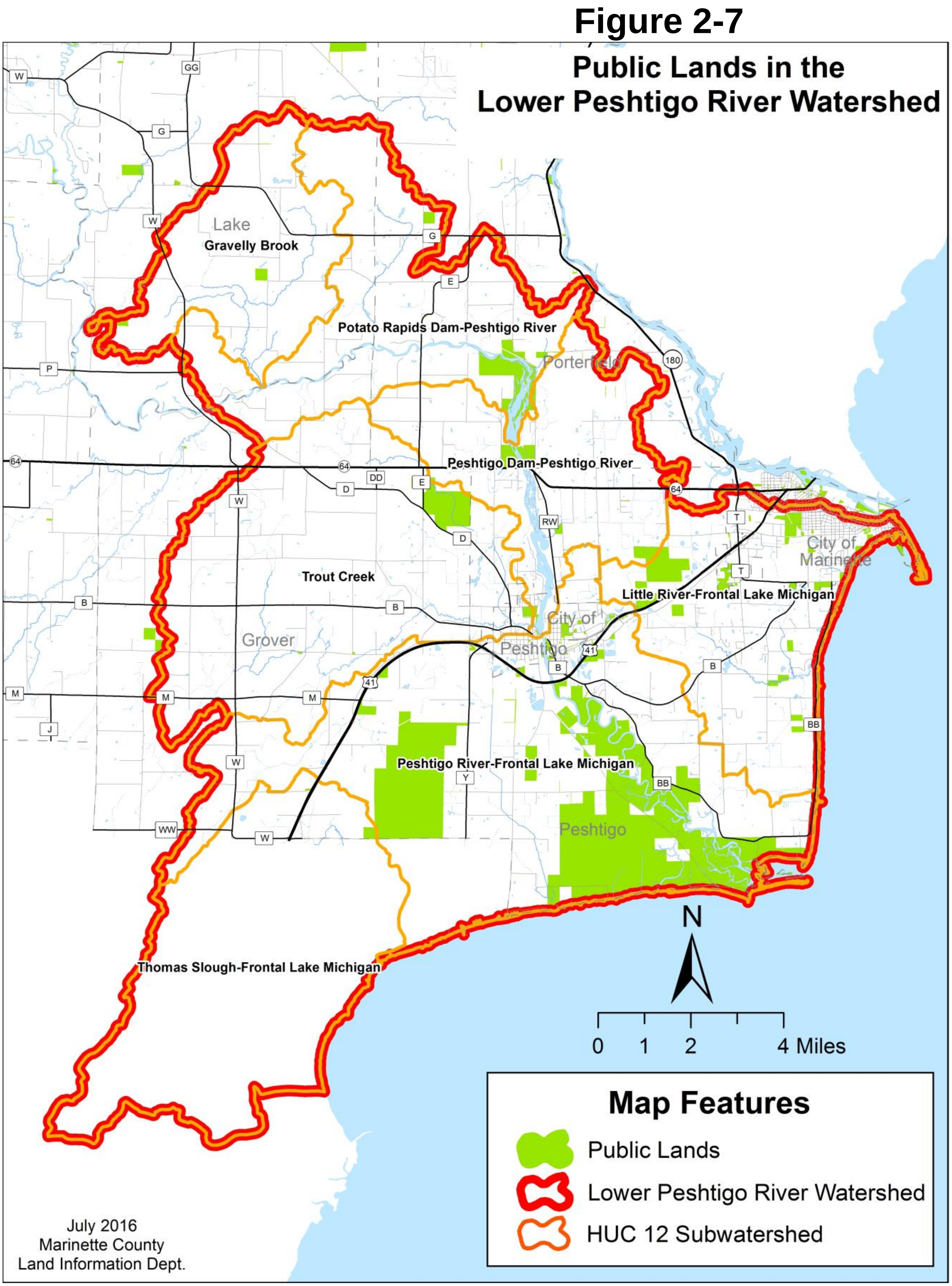


Figure 2-7
Public Lands in the
Lower Peshtigo River Watershed
Lake
Gravelly Brook
Potato Rapids Dam-Peshtigo River
Porterfield
Peshtigo Dam-Peshtigo River
Trout Creek
City of
Marinette
Little River-Frontal Lake Michigan
City of
Peshtigo
Grover
Peshtigo River-Frontal Lake Michigan
Peshtigo
Thomas Slough-Frontal Lake Michigan
N
0 1 2 4 Miles
Map Features
Public Lands
Lower Peshtigo River Watershed
HUC 12 Subwatershed
July 2016
Marinette County
Land Information Dept.

Subwatershed Discussions

This discussion is heavily based on information from the Upper Green Bay Basin Integrated Management Plan and the Wisconsin Department of Natural Resources website (http://dnr.wi.gov/) Surface Water Data Viewer. Seven HUC 12 subwatersheds are contained completely or partially within the watershed, as shown in Figure 2-7. Physical character and land use in the subwatersheds change from northwest to southeast. Forestry and recreation land uses decrease while agricultural and residential land use increase. For additional discussion on land use within each subwatershed see Figure 2-8 below.

Figure 2-8. Sub Watershed Discussions and Comments

Sub Watershed (HUC 12)	HUC Area (Acres)	Sub Watershed Discussions
Gravelly Brook (040301050601)	10,425	Northern portion of this HUC contains extensive wetlands; one farm installed BMP's. The dominant soil type is **Emmet**, consisting of deep, well drained soils on moraines and drumlins formed in predominantly loamy till. Permeability ranges from moderate to moderately rapid.
Potato Rapids Dam – Peshtigo River (040301050602)	16,132	Contains Potato Rapids (Bagley) Flowage; the flowage is largely surrounded by State and Wisconsin Public Service Corporation land; three farms installed BMP's. The dominant soil type is **Emmet**, consisting of deep, well drained soils on moraines and drumlins formed in predominantly loamy till. Permeability ranges from moderate to moderately rapid.
Trout Creek (040301050603)	23,517	Most intensely farmed HUC 12; site of 19 completed farm runoff projects; drains directly into Peshtigo Flowage in the City of Peshtigo; 2014 and 15 stream monitoring showed dissolved phosphorus exceeded the state standard in multiple samples. SNAP+ will be run on the entire subwatershed. The dominant soil type is **Emmet**, see above
Peshtigo Flowage Dam – Peshtigo River (040301050604)	12,632	One completed farm runoff project; Contains Peshtigo Flowage and City of Peshtigo; excessive sediment builds up at the mouth of Trout Creek; the City dredged a portion of the flowage in 2012 after obtaining an EPA grant. The dominant soil types are **Emmet** (SEE ABOCE), and **Wainola**, consisting of deep, somewhat poorly drained, rapidly permeable soils on outwash and glacial lake plains formed in sandy pockets.
Little R – Frontal Lake Michigan (040301050605)	14,323	This HUC 12 stopped below the southern edge of the City of Marinette in the UGB Basin Plan; at the WDNR website it contains the southern half of the city; there is little agriculture in this HUC. Excluding the city of Marinette, the dominant land uses are forest, wetland, and rural residential. Two phragmites control projects occurred along Green Bay shoreline. The dominant soil type is **Wainola**, see above.
Peshtigo River - Frontal Lake Michigan (040301050606)	35,028	Contains the mouth of the Peshtigo River and the 5,424 acre Peshtigo Harbor Wildlife Area; the most undeveloped Wisconsin river mouth on Lake Michigan. The dominant soil type is **Wainola**, see above)
Thomas Slough – Frontal Lake Michigan	21,491	This HUC 12 was NOT part of the LPRW HUC 10 in the UGB Basin Plan; it IS part of the WDNR website delineated boundary; this fact was not determined until late in the planning process, no monitoring was done in the HUC; approximately 90% lies in Oconto County. The dominant soil type is **Solona,** deep, somewhat poorly drained, moderately permeable soils on ground moraines formed in calcareous, loamy till.

Flowages

Potato Rapids (Bagley) Flowage was created by the Peshtigo Pulp and Paper Company during 1920 - 1921. Wisconsin Public Service Corporation obtained the hydroelectric facility in 1925 and still operates it today. It is almost entirely surrounded by Wisconsin Department of Natural Resources Land. The balance is owned by Wisconsin Public Service Corporation (WPSC).

The flowage is very riverine in nature with multiple flowing channels and many dead-end backwater channels. It covers 281 acres, has a maximum depth 20 feet, mean depth of 7 feet, and 8.2 miles of shoreline. The drainage area is 38 square miles and 32 acres of adjoining wetlands.

Peshtigo Flowage is located near the bottom of the Lower Peshtigo River watershed. It was formed by the Peshtigo Dam in 1920. The dam is owned and operated by the WPSC. The dam maintains a head of 13 feet. Its Federal Energy Regulatory Commission requires water level in the flowage to be maintained at 603 feet NGVD above sea level.

The surface area of Peshtigo Flowage is 232 acres, including Trout Creek pond, a widening of Trout Creek, just west of the main flowage. While many natural lakes have a flushing rate measured in years, on average it takes only 19 hours to replace the entire volume of Peshtigo Flowage with "new" water from the Peshtigo River. The flushing rate is important because it impacts nutrient dynamics (how quickly nutrients are stored, flushed, and recycled).

Flowage water quality was monitored in 1999 and 2000 as a part of a Lake Management Plan. Water quality was good, with phosphorus concentrations at 26.9 ug/L, well below the 65 ug/L state average for flowages. Phosphorus levels in Trout Creek Pond were considerably higher, at 52.2 ug/L. Water clarity was fair in the flowage, with moderately stained water. This condition is caused by dissolved organic chemicals in the water called tannins.

The shoreline of Peshtigo Flowage is heavily developed with numerous permanent and seasonable dwellings. Development within the City of Peshtigo is a mix of single-family homes, multi-unit development, institutional, and public green space. The City of Peshtigo maintains a boat landing, swimming beach, and more than 2700 feet of park/green space on the flowage.

In 2012 an Aquatic Invasive Species Management Plan was developed to create a sustainable plan for the long-term management of aquatic plants in Peshtigo Flowage with emphasis on control of the Eurasian watermilfoil (*Myriophyllum spicatum*), and other invasive exotic species. The City of Peshtigo has been managing aquatic plants in the flowage since the mid 1980's including the use of aquatic herbicides and mechanical harvesting.

The triple threat of increasing nutrient enrichment from agricultural areas, reduced flows, and longer growing seasons is one shared by many area lakes and flowages. Although the phosphorus levels are well below the statewide average for impounded waters, they are still considerably higher than would be expected in a natural lake. Within the main body of the flowage where the flushing rate is high, algae flush out of the system before they can become a nuisance. In calmer backwater areas where water movement is less the system acts more like a nutrient rich lake with nuisance algae blooms.

In 2012 the Marinette County Land and Water Conservation Division helped the City of Peshtigo with a dredging project to remove sediment from the flowage and improve control of Eurasian watermilfoil.

Streams

The Lower Peshtigo River Watershed contains seven rivers and streams with a total length of 84 miles. See Figure 2-9 below.

Stream Name	WBIC	Length in Miles	Codified Use		
Peshtigo River	515500	26	WWSF		
Trout Creek	51900	6	WWFF		
Sucker Brook	51600	9	DEF		
Bundy Creek	516100	12	WWFF		
Mud Brook	516900	7	DEF		
Gravelly Brook	517100	7	WWFF		
Little River	583200	6	WWSF		
Definitions	WBIC – Water Body Identification Code		WWSF – Warm Water Sport Fish Community WWFF - Warm Water Forage Fish Community Cold Class II – Cold Water Community, insufficient natural reproduction DEF – Default designation		

Groundwater

Groundwater is the main source of drinking water in Marinette County. Groundwater is stored underground in pore spaces and cracks within the soil and rock layers. Unconsolidated material and rock layers which hold groundwater are called aquifers.

The southeastern third of the county is underlain by the Potsdam Sandstone, Saint Peter Sandstone, and the Lower Magnesian and Trenton limestone formations. Overlying glacial deposits are aquifers.

Groundwater flows from recharge areas such as hills and exposed bedrock to discharge areas such as lakes, rivers, and wetlands. Regional recharge areas are typically farther from discharge areas. The direction of regional flow is southeast toward Green Bay. Recharge areas for local groundwater flow are generally closer to discharge areas. In most cases, local groundwater flow follows the topography.

Sandy soils, a high water table, or shallow bedrock are among the conditions that make ground water susceptible to contamination. The WDNR considers the Lower Peshtigo River watershed to have high potential for groundwater contamination for one or more of these conditions. Additional work will need to be done to obtain a more accurate and current picture of the ground water conditions in the watershed. Chapter five (Figure 5-1) explains in greater detail the plans for characterizing watershed ground water resources and developing a strategy to reduce groundwater contaminations sources.

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Chapter 3. Causes and Sources

Land use

Pre-European settlement vegetative cover in Lower Peshtigo River watershed was once predominantly Northern Mesic Forest (Maple, Hemlock, Yellow Birch) and conifer-hardwood forest, Conifer Wetlands (Black Spruce, Tamarack, Cedar) and Sedge Meadows (Sedges, Blue Joint, Cordgrass) near the mouth of the Peshtigo river. By 1910 two-thirds of Marinette County was logged over, including almost all the forested portions of the watershed. With the trees largely gone, land use changed drastically, shifting to agriculture, incorporated areas, and roadways. See Figure 3-1 for a sampling of the recent major land uses in the watershed.

Marinette County continues to be fragmented into increasingly smaller parcels as larger holdings are sold off for recreational land and subdivisions. The Lower Peshtigo Watershed lies in the Towns of Beaver, Grover, Lake, Peshtigo, and Porterfield and encompasses the City of Peshtigo. These areas had 16,699 parcels in 2000. That number increased by 1,004 to a total of 17,703 parcels in 2015, a 6.0% increase in 15 years. The rate of fragmentation is the least in the City of Marinette and greatest in the Town of Lake.

Population

The Populations of the Towns and Cities have held relatively stable in the last five years. The Figure 3-1 below shows the populations and growth rates within the main political boundaries. All numbers are for the entire Town or City, not just the portions contained in the watershed.

Figure 3-1. Populations and trends in watershed political boundaries

Town or City	Population as of July, 2015	Growth or Decrease Rate
Beaver	1,149	+0.05%
Grover	1,794	+0.28%
Marinette, City	10,968	-1.0%
Peshtigo, City	3,469	-0.18%
Peshtigo, Town	4,090	+0.15%
Porterfield	1,794	+0.03%

Comprehensive Planning

All five Towns and the Cities have developed comprehensive land use plans. Marinette County has greatly expanded its Geographic Information System (GIS) capability to meet the needs of local government in making these plans and deal with the challenges of additional growth.

In February of 2010 Marinette County adopted a 20-Year Comprehensive Plan to provide the *“policy framework from which county officials will refer to when making their future land use decisions. This comprehensive plan was prepared to address the future development and preservation concerns affection the county during the next 20 years.”*

Transportation

The major roads that run through the Lower Peshtigo River Watershed include State Highways 41 and 64. Highway 64 runs east and west, roughly splitting the watershed in half. Highway 41 connects the Cities of Peshtigo and Marinette. It is the main entry point to Michigan from Marinette County. Highway 41 is the main artery connecting south eastern Marinette County with Green Bay to the south.

A number of County Highways, B, BB, D, E, G, M, RW, T, W, and Y serve the Towns in the watershed. Two railroad lines enter the watershed from the northwest and southwest, meeting in the City of Marinette.

Industrial and Municipal Waste Water dischargers

According to the Wisconsin Department of Natural Resources Wisconsin Pollution Discharge Elimination System web page, there are no industrial waste water permit holders in the LPRW. The municipal permit holders are the Peshtigo Joint Wastewater Treatment Facility and the Marinette Wastewater Utility.

Storm Water Runoff

The City of Marinette is the sole MS4 permittee in the County. The City’s permit provides minimum pollutant loading analyses for total suspended solids and phosphorus, including percent TSS reductions to be assessed and areas required to be included in the calculations. The MS4 TMDL Implementation Guidance provides direction to MS4 permittees and their consultants on how Total Maximum Daily Load (TMDL) waste load allocations will be implemented within MS4 permits. This guidance also discusses how an MS4 permittee will be expected to model its MS4 service area and storm water management measures to show compliance with TMDL requirements.

Land cover

Land Use and Land Cover data for the Lower Peshtigo River watershed was obtained from the National Land Cover Database (NLCD 2011). The NLCD 2011 has a spatial resolution of 30 meters. The classification of land use is based on 2011 Landsat satellite data. Figure 3-2 below displays the main land cover types and uses in the watershed. The Common Resource Areas (CRA) Inset shows geographical areas where resource concerns, problems and treatment needs are similar. The Lower Peshtigo River Watershed has two CRAs.

95A.WI1 Eastern Wisconsin Till Plain

Gently sloping till plain with moderately well drained to somewhat poorly drained loamy and clayey soils, and poorly drained organic soils in the depressions. Lake Winnebago and Lake Michigan shorelines and significant wetland complexes are included. Cropland is the major land use with some large dairy farms, grazing land, and deciduous and coniferous forestland.

Development pressure is high. Primary resource concerns are cropland and construction site erosion, storm water management, nutrient management, surface water and ground water quality, and wetland habitat management and restoration.

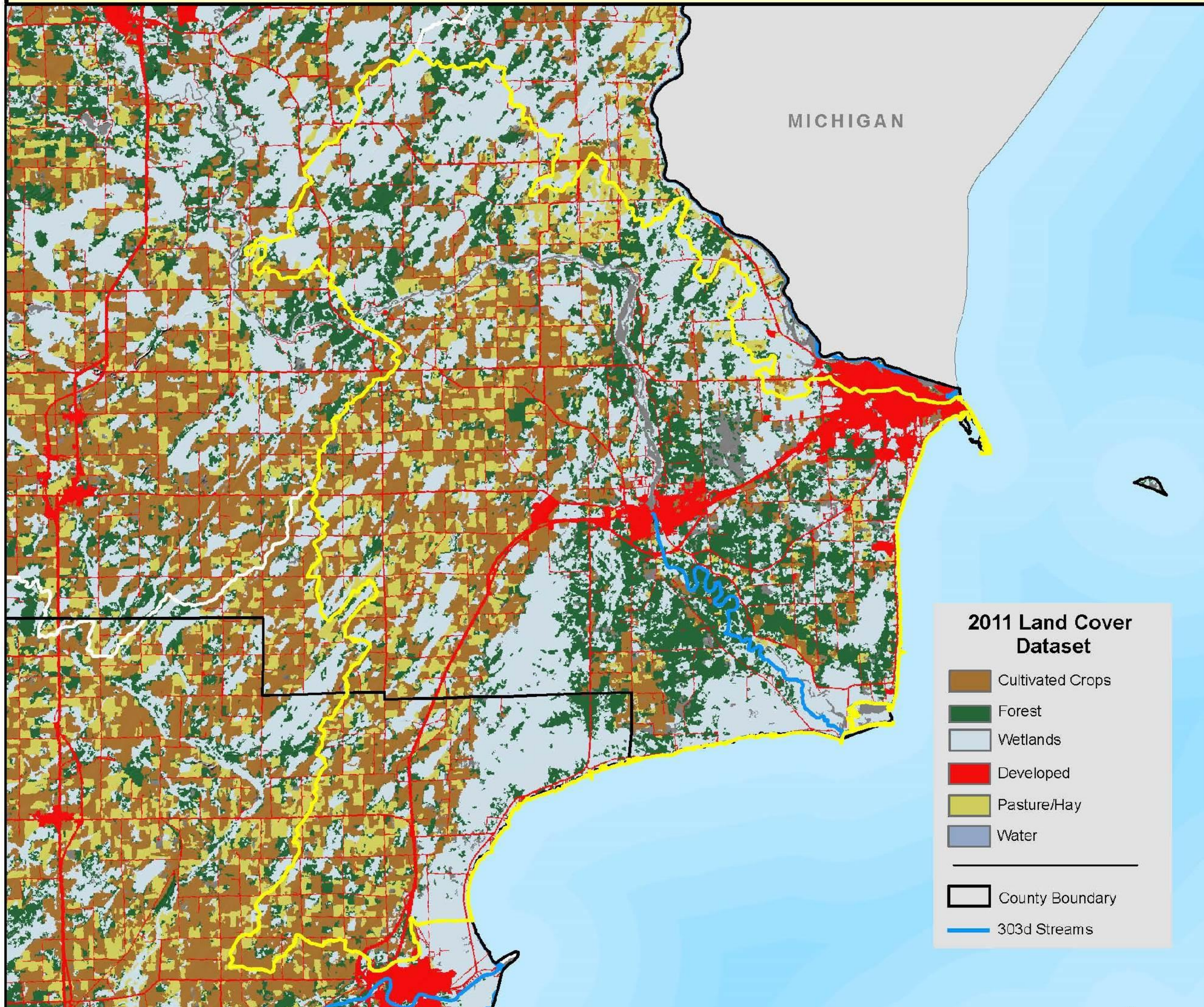
94B.MI2. Eastern Upper Peninsula Sandy Drift

Characterized by a mixture of low-relief ground moraines, lacustrine deposits, and glaciofluvial deposits, this area is covered about equally with glacial lake plain, till, and outwash deposits. Recreation is an important land use, especially along the major streams and on sites bordering Green Bay and Lake Michigan. Land in farms is about equally divided between pasture and farm woodlots. Primary resource concerns are water erosion, excessive soil wetness, soil fertility, and soil tilth. A combination of surface and subsurface drainage systems is needed in most areas of poorly drained soils.

Lower Peshtigo River-Frontal Lake Michigan HUC 10 — Figure 3-2

Land Cover & Common Resource Areas

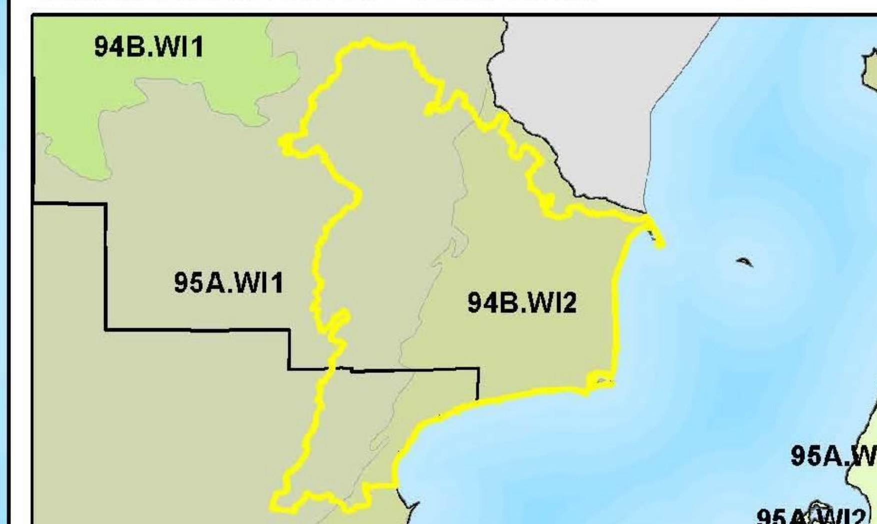
United States Department of Agriculture
Natural Resources Conservation Service



Land Cover	Acres	Land Cover %
Wetlands	49,069	37%
Cultivated Crops	27,670	21%
Forest	26,866	20%
Pasture/Hay	13,714	10%
Developed	11,194	8%

*Land Cover data includes public lands

Common Resource Areas Inset

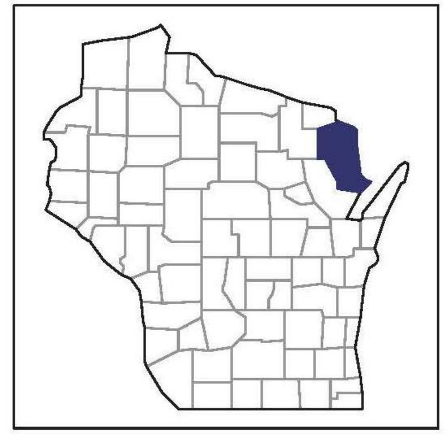


CRA	Acres	CRA %
95A	68,414	51%
94B	65,075	49%

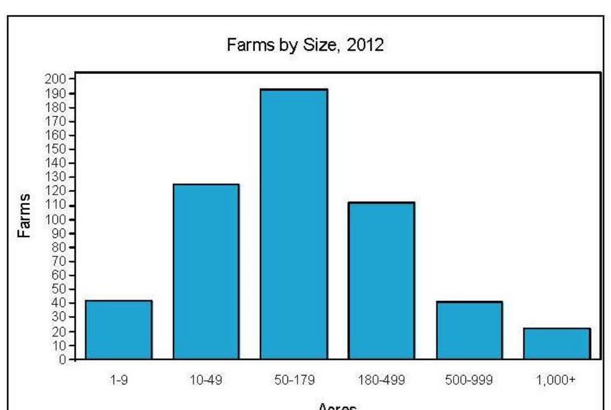
95A Northeastern Wisconsin Drift Plain
94B Michigan Eastern Upper Peninsula Sandy Drift

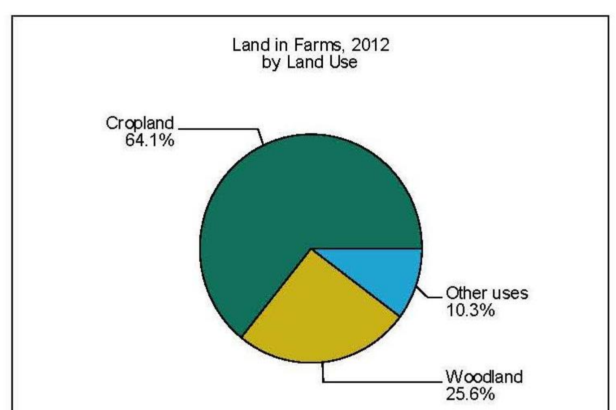
2012 CENSUS OF AGRICULTURE
COUNTY PROFILE

Marinette County
Wisconsin



	2012	2007	% change
Number of Farms	535	746	- 28
Land in Farms	132,074 acres	144,303 acres	- 8
Average Size of Farm	247 acres	193 acres	+ 28
Market Value of Products Sold	$101,440,000	$66,904,000	+ 52
Crop Sales $29,101,000 (29 percent) Livestock Sales $72,339,000 (71 percent)			
Average Per Farm	$189,608	$89,684	+ 111
Government Payments	$1,557,000	$1,249,000	+ 25
Average Per Farm Receiving Payments	$6,983	$4,264	+ 64





USDA US Department of Agriculture
National Agricultural Statistics Service
www.agcensus.usda.gov

2012 CENSUS OF AGRICULTURE
COUNTY PROFILE

Figure 3-3

Marinette County – Wisconsin

Ranked items among the 72 state counties and 3,079 U.S. counties, 2012

Item	Quantity	State Rank	Universe [1]	U.S. Rank	Universe [1]
MARKET VALUE OF AGRICULTURAL PRODUCTS SOLD ($1,000)					
Total value of agricultural products sold	101,440	47	72	1,155	3,077
Value of crops including nursery and greenhouse	29,101	54	71	1,501	3,072
Value of livestock, poultry, and their products	72,339	41	72	678	3,076
VALUE OF SALES BY COMMODITY GROUP ($1,000)					
Grains, oilseeds, dry beans, and dry peas	20,014	54	71	1,235	2,926
Tobacco	-	-	10	-	436
Cotton and cottonseed	-	-	-	-	635
Vegetables, melons, potatoes, and sweet potatoes	5,468	18	70	344	2,802
Fruits, tree nuts, and berries	103	61	70	1,405	2,724
Nursery, greenhouse, floriculture, and sod	1,194	41	71	996	2,678
Cut Christmas trees and short rotation woody crops	588	5	67	54	1,530
Other crops and hay	1,734	51	71	1,459	3,049
Poultry and eggs	49	54	72	1,631	3,013
Cattle and calves	15,501	38	72	991	3,056
Milk from cows	55,121	36	68	150	2,038
Hogs and pigs	111	44	70	1,230	2,827
Sheep, goats, wool, mohair, and milk	(D)	(D)	68	(D)	2,988
Horses, ponies, mules, burros, and donkeys	92	42	69	1,898	3,011
Aquaculture	(D)	23	53	(D)	1,366
Other animals and other animal products	1,310	20	70	199	2,924
TOP CROP ITEMS (acres)					
Forage-land used for all hay and haylage, grass silage, and greenchop	29,588	37	72	612	3,057
Corn for grain	27,166	48	69	850	2,638
Corn for silage	11,028	33	69	155	2,237
Soybeans for beans	5,688	57	68	1,253	2,162
Vegetables harvested, all	2,707	20	70	261	2,801
TOP LIVESTOCK INVENTORY ITEMS (number)					
Cattle and calves	38,699	39	72	720	3,063
Layers	1,253	56	72	1,682	3,040
Horses and ponies	913	47	72	1,308	3,072
Hogs and pigs	894	38	70	1,071	2,889
Broilers and other meat-type chickens	696	43	71	1,091	2,723

Other County Highlights, 2012

Economic Characteristics	Quantity
Farms by value of sales:	
Less than $1,000	129
$1,000 to $2,499	55
$2,500 to $4,999	54
$5,000 to $9,999	59
$10,000 to $19,999	43
$20,000 to $24,999	13
$25,000 to $39,999	31
$40,000 to $49,999	7
$50,000 to $99,999	25
$100,000 to $249,999	37
$250,000 to $499,999	40
$500,000 or more	42
Total farm production expenses ($1,000)	80,524
Average per farm ($)	150,512
Net cash farm income of operation ($1,000)	24,221
Average per farm ($)	45,272

Operator Characteristics	Quantity
Principal operators by primary occupation:	
Farming	276
Other	259
Principal operators by sex:	
Male	496
Female	39
Average age of principal operator (years)	58.3
All operators by race [2]:	
American Indian or Alaska Native	-
Asian	-
Black or African American	-
Native Hawaiian or Other Pacific Islander	-
White	855
More than one race	2
All operators of Spanish, Hispanic, or Latino Origin [2]	-

See "Census of Agriculture, Volume 1, Geographic Area Series" for complete footnotes, explanations, definitions, and methodology.
- Represents zero. (D) Withheld to avoid disclosing data for individual operations.
[1] Universe is number of counties in state or U.S. with item. [2] Data were collected for a maximum of three operators per farm.

Agriculture

Marinette County contains approximately 132,074 acres of farmland (see Figure 3-3 2012 USDA Census of Agriculture data). Continuing a long trend, the number of Marinette County farms dropped by 28% between 2007 and 2012. Also, continuing a long trend, average Marinette County farm size increased 28% in that time period. Interestingly, the amount of land acreage in farms only decrease by 8%. The number of dairy cattle has also remained stable.

The overall trend for dairy operations in Marinette County is farms are becoming fewer in number but larger in size. Cropland acreage continues to decrease but at a much slower rate. Two common scenarios are for retiring farmer to stay on at the home farm while renting the cropland or to sell entirely. If the whole farm is divested, it is often split, the farm stead sold with minimal attached acreage, as a residence or hobby farm and the cropland sold to another commercial operation.

Unintended consequences develop from this scenario. Private well head areas may be completely surrounded by cropland under the control of others. This may place drinking water sources at a higher level of risk. The sold cropland may be some distance from the purchaser. This makes nutrient management, especially manure hauling, more labor intensive. It also increases road traffic by implements of husbandry. Several Marinette County Towns are dealing with damaged roads and complaints from nonfarm motorists. Lastly, when many farms cease operations, unused agricultural chemical such as herbicides and pesticides often remain on site.

The Lower Peshtigo River Watershed contains 41,384 acres of cultivated cropland, pasture, and hay land according to 2011National Land Cover Data Base. Map 3-2 shows the land uses in the Lower Peshtigo River Watershed. Approximately 88% of its area is in Marinette County and 12% in Oconto County.

In 2005 (Figure 3-5), a Marinette County staff person drove all the agricultural areas of Marinette County and recorded data on the farms found. It was known there are limitations on what can be learned by this type of effort, but given the poor quality of aerial photography available to Marinette County and staff time limitations, this was deemed the best option. The key data gathered were farm building types, types of animals present, and an estimate of the farm size. In the Lower Peshtigo River watershed, a total of 216 farms were noted, from hobby to large operations.

In 2015 (Figure 3-6), recent high definition aerial photography was used to partially recreate the earlier survey. We did not revisit ninety-two farm sites delineated in the 2005 effort because they were known to be hobby farms, small or inactive. Based on professional judgement, it is unlikely these ninety-two farms are significant pollution sources or willing to install BMP's for water quality to help meet the plan's pollutant reduction goals. This left a total of 124 farms to be reviewed for the 2015 survey. The 2005 and 2015 efforts did not include Oconto County. Table 3-4 below summarizes the results of the 2015 survey.

Figure 3-4 2015 Aerial Review of Selected LPRW Farm Sites

Farm Status	No. of Farms	Percent of Farms
Hobby	12	10.8%
Small (<50 cattle)	20	18.0%
Medium or larger (>50 cattle)	11	9.9%
Not Farm	3	2.7%
Inactive	48	43.2%
Active cost share	16	14.4%
Vegetable Farm	1	0.9%
Total Farms	111	

In 2005 we noted the loss of ninety-two farms from “commercial” status. From 2005 to 2015, an additional eighty farms became inactive, small, or hobby. The 2015 aerial photo survey does not account for all 124 farms deemed to be “commercial” in the 2005 effort. This may be due to use of two very different survey methodologies or the total removal of some barns and feedlots to make room for other development.

Additional work will be done to refine and “ground truth” this 2015 survey data. The 2015 survey results do suggest to who focus on when promoting the TRM program and EQIP to implement practices to help meet the pollutant reduction goals. Based on the number of inactive farms this information suggests Manure Storage Facility Abandonments and Well Decommissioning are BMP’s to focus upon in the near future to protect or restore surface and/or groundwater quality in the LPR watershed.

The 2015 survey also confirmed there are no farms in the watershed meeting the WDNR definition of Confined Animal Feeding Operation (CAFO).

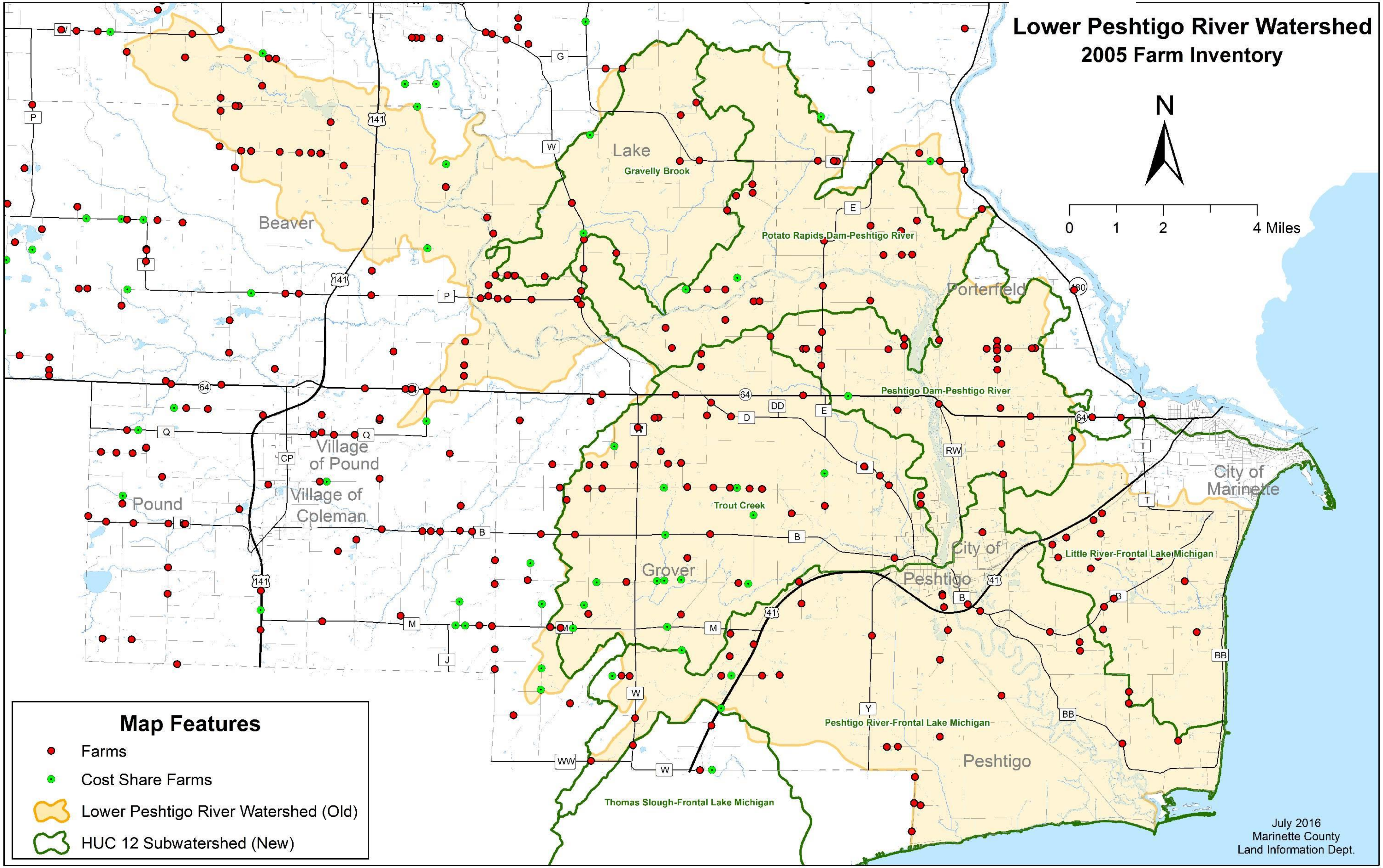


Figure 3-5
Lower Peshtigo River Watershed
2005 Farm Inventory

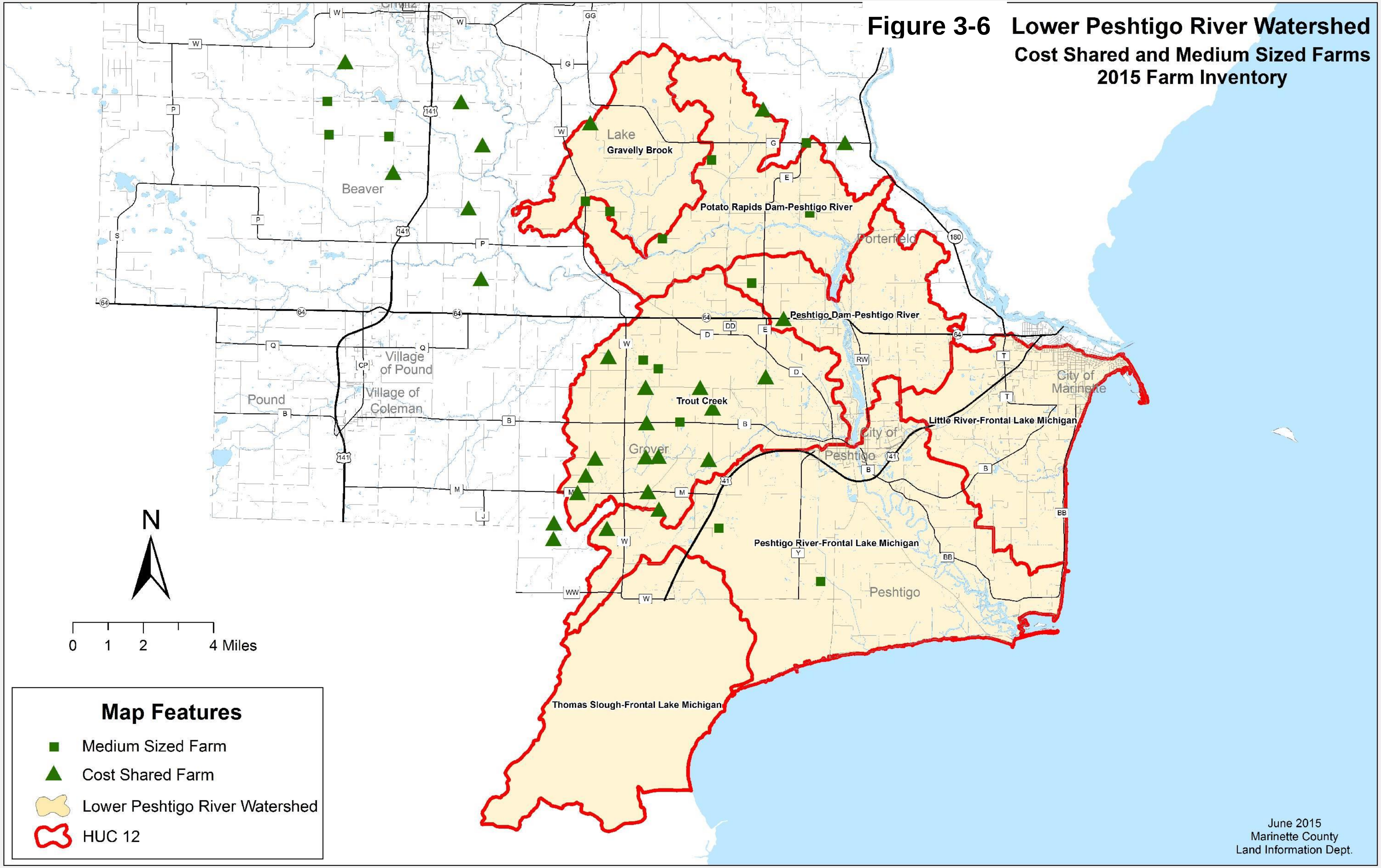


Figure 3-6 Lower Peshtigo River Watershed
Cost Shared and Medium Sized Farms
2015 Farm Inventory
Lake
Gravelly Brook
Potato Rapids Dam-Peshtigo River
Porterfield
Peshtigo Dam-Peshtigo River
Beaver
Village of Pound
Village of Coleman
Pound
Trout Creek
Grover
City of Peshtigo
City of Marinette
Little River-Frontal Lake Michigan
Peshtigo River-Frontal Lake Michigan
Peshtigo
Thomas Slough-Frontal Lake Michigan
N
0 1 2 4 Miles
Map Features
Medium Sized Farm
Cost Shared Farm
Lower Peshtigo River Watershed
HUC 12
June 2015
Marinette County
Land Information Dept.

Cropland soil erosion has not been observed as a serious sediment and phosphorus loading problem in Marinette County. Most of the cultivated agricultural acreage is located on gently sloping soils in the southern part of the county. The Northern Cropland Study, conducted in 1995, surveyed thousands of cropland acres in Marinette County. Cropland soil erosion was found to be negligible. That study estimated soil loss, greater than T (Tolerable Soil Loss), was occurring on less than one percent of all cropland. No cropland fields were found to be eroding at greater than two times the Tolerable Soil Loss rate.

The Marinette County LWCD conducted Erosion Transect Surveys in 2005 and 2008 following WDATCP protocols. The surveys covered 534 points and 315 road miles. These surveys corroborated the findings of the 1995 Northern Cropland Study. However, crop rotations have changed significantly in the last 20 years. For example, from 1997 to 2015 the acreage in corn has increased by 34% and soy beans by 500%. During the same period, alfalfa acreage decreased by 26%. Also, more corn is being harvested for silage rather than grain.

New tools such as EVAAL are becoming available to better predict areas of higher soil erosion potential. Over time, Marinette County will make use of new soil erosion tools and data to amend this plan and make informed decisions regarding the best fields to prioritize for erosion control practices to reduce pollutant loads and meet this plans P reduction goals.

In the Lower Peshtigo River Watershed there is little relief and soils tend to be moderate to highly permeable, ameliorating the conditions for crop field, pasture, and feed lot soil erosion. In any case, the EVAAL model will be employed to identify possible cropland erosion source areas and be followed up to investigate the tool's prediction. If areas of significant cropland erosion are discovered, landowners will be contacted regarding installation of appropriate BMP's. Figure 5-1 lists how cropland erosion will be investigated and analyzed. Figure 5-4 lists the schedule of activities to address cropland erosion.

Shoreline buffers (riparian vegetative buffers) reduce erosion, filter runoff, and provide wildlife habitat. On some of Marinette County's agricultural land, these important land/water interfaces are fragmented or absent. In a few areas, row crops are grown right up to the edge of intermittent and perennial streams. In other areas, cattle have direct access to surface waters, causing erosion and runoff pollution problems. These problems are apparent in some of the HUC 12 subwatersheds within the Lower Peshtigo River watershed. See Figure 1-1 on page 15 for a list of practices to address these erosion and runoff pollution problems by achieving compliance with applicable NR 151 standards and prohibitions.

At the time this plan is being written Marinette County lacks the staff resources to conduct watershed-wide monitoring to prioritize stream buffer restorations. Additionally, there are not currently state cost share programs available to incentivize buffer installations on a large scale. Therefore, until resources become available, Marinette

County’s buffer related efforts will be limited to individual projects focusing on Northern Pike habitat (See Figures 5-1 and 5-3) and eradication of pioneer invasive species infestation (See Figures 5-1 and 5-3).

The following NRCS standards and ATCP 50 SOIL AND WATER RESOURCE MANAGEMENT PROGRAM sections may be used to design and implement Shoreline/Riparian buffers:

Standard 391
https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs143_014881.pdf
https://docs.legis.wisconsin.gov/code/admin_code/atcp/020/50/VIII/83

Standard 643-A
http://dnr.wi.gov/topic/shorelandzoning/documents/nrcsshorehabstandard.pdf
https://docs.legis.wisconsin.gov/code/admin_code/atcp/020/50/VIII/88

Standard 657
https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs143_026340.pdf

Standard 393
https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb1241319.pdf

Standard 342
https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs143_026475.pdf

Nutrient and pesticide management is a key component of the implementation strategy to reduce runoff pollution. Phosphorus is a primary contaminant of surface waters where it is the limiting aquatic plant and algae growth. One pound of phosphorus has been shown to support of 500 pounds of aquatic plant growth. Nitrogen is a known contaminant of ground water, but its presence is also an indicator that other agricultural chemicals may be present. See page 15 (Figure 1-1) for a list of practices to address these phosphorus runoff pollution problems by achieving compliance with applicable NR151 standards and prohibitions.

Groundwater quality in Marinette County is generally considered good. However, the aquifers are shallow and some soils overlying the aquifer are sandy and permeable and therefore, have a higher risk for leaching nutrients below the root zone and to ground water. Nitrate+nitrite and Triazine well sample analytical results have shown groundwater is being impacted by human activities in a limited way. Most municipalities in the county have no Wellhead Protection Plan to protect their water supply. There are unsealed abandoned wells. Many rural families and recreationists rely on shallow sand point wells for drinking water. These conditions lead to increased risk of groundwater contamination. This plan will focus on increasing the amount of Wellhead Protection Plans and decreasing the number of unsealed abandoned wells to protect water quality and drinking water supply.

Soils in the southern agricultural area of Marinette County are generally heavier, containing higher percentages of silt and clay. Soil testing shows that many fields contain excessive phosphorus levels. The nature of the soils, winter spreading of manure, fertilizer inputs in excess of crop needs, and a lack of shoreline buffers all contribute to phosphorus and sediment runoff pollution of surface waters.

For the first time, and as part of the development of this implementation plan, Marinette County staff obtained nutrient management plan data for multiple agricultural operations within the Lower Peshtigo River watershed. The results of this effort are shown in Figure 3-7 below. The soil phosphorus levels, in parts per million are symbolized by green, yellow and red parcels. As this is the first effort of this type, it is not possible to determine trends in soil phosphorus levels. However, at least for the farm cropland evaluated, soil phosphorus levels are generally not excessive, which are shaded red. Figure 5-4 lists the schedule of activities to improve P nutrient management and meet this plan’s pollutant reduction goals.

Figure 3-7 does not represent all of the agricultural parcels known to have nutrient management plans. It does provide a preliminary status report on soil phosphorus levels for some areas, primarily the two HUC 12 subwatersheds with the most cropland. One plan implementation goal (Figure 5-4) will be to obtain all the nutrient management plans for watershed farms and complete the Phosphorus Levels Map by 2020. However, meeting this goal will require additional staffing resources. The SNAP+ model will be run on the Trout Creek HUC12 subwatershed.

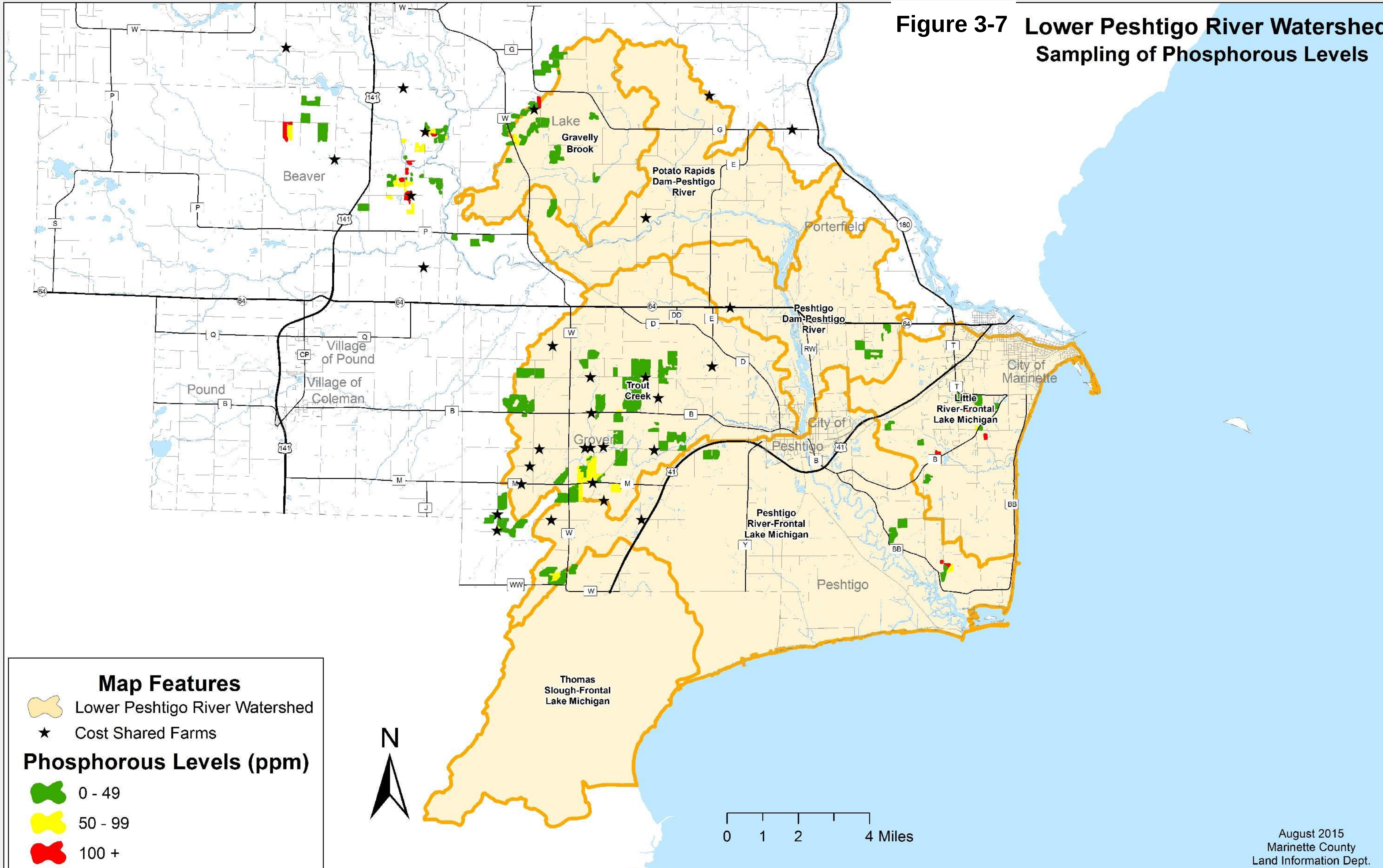


Figure 3-7 Lower Peshtigo River Watershed Sampling of Phosphorous Levels

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Chapter 4. Nonpoint Source Management Measures

The goals established in this plan will be implemented over a ten-year period beginning in 2016. They represent priorities for land & water resource management based on the environmental conditions in the watershed, the judgment of county staff and partner agencies, and especially citizen's concerns. Additionally, LWCD efforts are always steered and constrained by available resources. Those goals for which more resources can be brought to bear, will likely receive a higher level of focus. Ordinance development and enforcement will occur county-wide, as will educational efforts. Control and education efforts directed toward exotic invasive species will be determined by the locations and severity of outbreaks.

Figure 4-1 lists the current areas of program focus for Marinette County and its partners. Figure 4-2 shows LPRW accomplishments related to practices implemented to reduce nonpoint source pollution. Going forward, similar combinations of practices shown in Figure 4-2 will be implemented on additional cropland or feedlot areas to meet this plan's pollutant reduction goals

Figure 4-1. Existing Nonpoint Source Pollution Control and Related Efforts in the Lower Peshtigo River Watershed

Stakeholder	Existing Program	Pollutant or Issue Addressed
USDA Natural Resources Conservation Service	Environmental Quality Incentives - Cropland - Pasture - Forest - Farmstead	 Nutrients, sediment Nutrients, sediment Habitat, invasive species Nutrients, BOD
Wisconsin Department of Natural Resources	Targeted Runoff Management Aquatic Invasive Species Control	Nutrients, BOD Habitat
Wisconsin Department of Agriculture, Trade, and Consumer Protection	Land and Water Resources Management	Nutrients, sediment. BOD
Peshtigo, City of	Aquatic Plant Harvesting	Invasive species, habitat
Marinette County Land Information Department – Land and Water Conservation Division	Participates in, or assists with, the programs above	
Wild Rivers Invasive Species Coalition	Prevention, control, and eradication of terrestrial and aquatic invasive species	Invasive species, habitat

Figure 4-2 Completed Constructed Best Management Practices
Lower Peshtigo River Watershed (2003 – 2014)

HUC 12	Project ID	Practices	Acres Not Winter Spread	Manure Storage Facility	Barnyard Runoff Management	Milking Center Waste Control	Barnyard Roof	Manure Storage Roof	Waste Transfer System	Animal Lot Abandonment	Manure Storage Syst. Closure	Feed Storage Leachate	Miscellaneous BMP's
Potato Rapids Dam - Peshtigo River	2003 A	Abandoning Animal Feeding Ops. - Stab.								1			
		Abandoning Animal Feeding Ops.								1			
Trout Creek	2003 C	Manure Storage Facility	300	1									
		Milking Center Waste Control				1							
Trout Creek	2003 B	Manure Storage Facility	491	1									
		Milking Center Waste Control				1							
		Barnyard Runoff Management			1								
Trout Creek	2003 C	Manure Storage Facility	360	1									
		Milking Center Waste Control				1							
Peshtigo Dam - Peshtigo R	2004 F	Manure Storage Facility	1100	1									
		Manure Storage Roof						1					
		Barnyard Runoff Management			1								
		Barnyard Roof					1						
Peshtigo River Frontal - Lake Michigan	2004 D	Manure Storage Facility	650	1									
		Milking Center Waste Control				1							
		Barnyard Runoff Control System			1								
Trout Creek	2004 C	Barnyard Runoff Management	450		1								
		Manure Storage Facility		1									
		Milking Center Waste Control				1							
Trout Creek	2004 A	Abandoning Animal Feeding Operations								1			
		Abandoning Animal Feeding Ops. - Stab.											1
Trout Creek	2005B	Manure Storage	570	1									
		Milking Center Waste Control				1							
		Waste Transfer System							1				
Trout Creek	2005C	Manure Storage System	425	1									
		Barnyard Runoff Control System			1								
		Milking Center Waste Control				1							
		Waste Transfer System							1				
		Manure Storage System Closure									1		
Trout Creek	2005B	Barnyard Runoff Control System			1								
Trout Creek	2007 C	Manure Storage System	350	1									
		Barnyard Runoff Control System			1								
		Milking Center Waste Control				1							
		Waste Transfer System							1				
		Roof for Barnyard Runoff Mgmt.					1						
Trout Creek	2008 F	Manure Storage System	1300	1									
		Barnyard Runoff Control System			1								
		Waste Transfer System							1				
Trout Creek	2008 I	Manure Storage System	700	1									
		Barnyard Runoff Control System			1								
		Milking Center Waste Control				1							
		Waste Transfer System							1				
Potato Rapids Dam - Peshtigo River	2009 A	Manure Storage System	290	1									
		Barnyard Runoff Control System			1								
		Barnyard Roof					1						
		Waste Transfer System							1				
Trout Creek	2010 B	Manure Storage System	see 08 F	1									
		Barnyard Runoff Control System			1								
Trout Creek	2010 D	Manure Storage System	680	1									
		Barnyard Runoff Control System			1								
		Waste Transfer System							1				
Trout Creek	2010 F	Manure Storage System	365	1									
		Barnyard Runoff Control System			1								
		Manure Storage Roof						1					
		Barnyard Roof					1						
Trout Creek	2010 G	Barnyard Runoff Control System			1								
		Waste Transfer System							1				
Gravelly Brook	2011 B	Manure Storage System	230	1									
		Roof for Manure Storage Facility						1					
		Waste Transfer System							1				
Trout Creek	2011 A	Barnyard Runoff Control System			1								
		Roof for Barnyard Runoff Mgmt.					1						

Completed Constructed Best Management Practices
Lower Peshtigo River Watershed (2003 – 2014) **Cont.**

HUC 12	Project ID	Practices	Acres Not Winter Spread	Manure Storage Facility	Barnyard Runoff Management	Milking Center Waste Control	Barnyard Roof	Manure Storage Roof	Waste Transfer System	Animal Lot Abandonment	Manure Storage Syst. Closure	Feed Storage Leachate	Miscellaneous BMP's
Trout Creek	2013 A	Feed Storage Leachate										1	
		Waste Transfer System							1				
Trout Creek	LWP-05	Manure Storage Facility	578	1									
		Milking Center Waste Control				1							
		Manure Storage Facility Aband.									1		
		Waste Transfer							1				
Trout Creek	LWP04	Manure Storage Facility	360	1									
		Milking Center Waste Control				1							
Trout Creek	LWP04/05	Milking Center Waste Control				1							
		Manure Storage Fence											1
Trout Creek	LWP-11	Heavy Use Prot./ Barnyard Runoff Ctrl.			1								
Trout Creek	LWP-12	Heavy Use Protection Area			1								
Trout Creek	LWP-13	Manure Transfer						1					
Potato Rapids Dam - Peshtigo River	LWP-15	Manure Storage Facility	310	1									
		Waste Transfer System							1				
		Barnyard Runoff Management			1								
Peshtigo Dam - Peshtigo R	LWP-20	Barnyard Runoff Management			1								
		Subsurface Drain											1
		Roof for Barnyard Runoff Management					1						
Trout Creek	LWP-24	Subsurface Drain											1
			9,509	19	19	12	6	4	12	3	2	1	4

Note: Since 2002, farms receiving WDNR or DATCP cost sharing for the Manure Storage Facility BMP have been required to also have a 590 Standard Compliant Nutrient Management Plan, which when implemented, reduce soil erosion and phosphorus losses from cropland and pastures. In some cases the plans were developed at landowner cost. In others, the operator received cost sharing from DATCP or NRCS.

Estimated Reductions in Contaminants from Plan Implementation

Estimating necessary load reductions to meet water quality standards in the absence of an approved TMDL is difficult. Limited staff resources have forced Marinette County to choose between putting conservation practices on the land and performing the costly and labor intensive monitoring and surveying need to perform this kind of estimate. This plan employs new tools such as the Healthy Watersheds Assessment, EVAAL, STEPL, and others which may change the situation and allow for more frequent and efficient load reduction estimates and monitoring of practice implementation to verify load reductions are being maintained over time.

From 2003- 2014 thirty-one constructed agricultural projects have already been installed in the Lower Peshtigo River (LPR) watershed. For each project, significant conservation planning, surveys, and data gathering occurred. This information provides the basis for initial application of the STEPL model and general estimates of environmental benefits provided by installation and implementation of additional agricultural best management practices on farmsteads and associated cropland and pasture.

It is important to comment on the data and provide a caveat on its use. Estimates of cropland owned and/or controlled are based on recollections of the farm operators, not on a detailed land records search. Many of the farms analyzed have grown or changed in the last fourteen years. Furthermore, competition for cropland has resulted in operators traveling up to 10 miles from the manure storage facility. Therefore, farms based in the LPR watershed may be farming on lands outside the watershed while farms based outside the LPR watershed are farming within it. Lastly, the spreadsheets, models, definitions and measuring accuracy have all evolved. These realities make it very difficult to estimate how many acres in the LPR watershed are being farmed under an existing nutrient management plan, for example.

Winter spreading of Manure

Marinette County has installed manure storage facilities at sixteen farms within the LPR watershed. The average amount of manure, bedding, urine, etc. generated from each farms is 1,205,000 gallons annually. This plan estimates approximately half of this volume may be winter spread (i.e., frozen or snow covered soils) under normal conditions if these operations did not have a storage facility. If the remaining fifteen animal operations in the watershed without manure storage install a facility, it is possible 9,037,500 gallons of animal waste will be stored and prevented from being land applied and then leaving croplands during winter/spring melt periods.

The University of Wisconsin – Discovery Farm obtained six years of runoff data from a Wisconsin farm *(Manure Applications on Frozen and/or Snow Covered Ground, Summer 2012)*. Study results showed 50% of annual runoff from crop fields occurred in February and March.

80% of the phosphorus loss for the entire year occurred during this time period. Based on data from Discovery Farm Sites across Wisconsin, “manure applications during the time period around snowmelt have a high potential to deliver nutrients to areas of concentrated flow through surface water runoff.”

Figure 4-5 compares the predicted pollution reductions from installation of **waste management systems** and combined **reduced tillage/nutrient management planning** to pre BMP conditions using EPA’s STEPL tool. We used data from sixteen farms that already installed BMP’s to determine averages for herd sizes, barnyard sizes, etc. To estimate the percentages of land covered by the BMP’s listed below in STEPL we divided the number of farms with completed BMP’s by the total number of farms we thought were still in commercial operation. Those farms were determined by viewing recent aerial photography of the LPR watershed.

The STEPL model outputs used in this assume a 60% reduction in Nitrogen and 67.5% reduction in Phosphorus for farms operating with a waste management system. Farms with storage facilities are better able to fully implement their nutrient management plans and totally avoid winter spreading of manure during high risk runoff conditions. The model also assumes a 30% reduction in Nitrogen, 60% in Phosphorus, and 75% in sediment from cropland that implement reduced tillage and nutrient management practices. These combined practices were selected to represent possible cropland practices and reductions that could be recommended as part of a full SnapPlus nutrient management plan.

Barnyard Phosphorus

The average amount of phosphorus running off of fifteen farmsteads for which we have BARNY data was 99.3 pounds annually prior to installation of best management practices. In each project all contaminated runoff was conveyed to a manure storage facility for proper land application via implementation of a 590 Standard nutrient management plan. There are an estimated fifteen farms in the LPR watershed that still need barnyard BMP’s. When these BMP’s are installed, STEPL predicts 1,571.1 pounds of phosphorus will be prevented from reaching waters of the state via concentrated flow annually.

Nutrient Management

In the absence of field by field data, there are multiple ways to estimate the number of acres under nutrient management plans in the watershed. The watershed producers that have worked with Marinette County, and for whom we have data, estimated they owned and/or rented an average of 509 acres per farm. Perhaps even more importantly, those farms that have received cost sharing for a manure storage facility are prohibited from spreading the contents of their facility on frozen or snow covered ground as well as managing croplands and pastures to minimize soil erosion within tolerable soil loss and have a rotational average PI of 6 or less. With an estimated fifteen farms in the watershed to work with, it is possible an additional 7,635 cropland acres will be operated under a nutrient management plan.

The 2011 USDA-NRCS Land Cover Data estimates there is 27,670 acres of cropland in the LPR watershed. If all the known and estimated medium or larger animal operations are placed under a nutrient management plan the total cropland for these farms will be 18,324 acres. This leaves 9,346 acres with an unknown nutrient management standing. Over this plan's ten year schedule, an extensive effort will be required to determine the status of these additional acres.

Using best professional judgement in each of the HUC 12 subwatershed to approximate the percentage of cropland in STEPL under nutrient management plans, estimates 8,500 acres are currently implementing nutrient management planning. Using best professional judgement again gives an estimate of 16,100 cropland acres under nutrient management plans with implementation of this plan. Appendix 2 shows how these figures were arrived at.

Using different methods we arrive at roughly the same answers, with 8,000-10,000 acres currently under nutrient management plans and 16,000 – 18,000 acres under plans at the conclusion of this nine key element plan.

General

Marinette County has obtained LiDAR data. Marinette County will use this data in EVAAL to locate fields with the high sediment and nutrient export potential. Such analysis will help further implement this plan's pollutant reduction goals for cropland and pastures. The SNAP+ model will be run on the Trout Creek HUC 12 using known or representative crop rotations, soil types, and soil P concentrations.

Figure 4-3 Estimated Pre-Project Pollution Loads

Total Load This is the summary of annual nutrient and sediment load for each subwatershed. This sheet is initially protected.

1. Total load by subwatershed(s)

Watershed	N Load (no BMP)	P Load (no BMP)	BOD Load (no BMP)	Sediment Load (no BMP)	N Reduction	P Reduction	BOD Reduction	Sediment Reduction	N Load (with BMP)	P Load (with BMP)	BOD (with BMP)	Sediment Load (with BMP)	%N Reduced	%P Reduced	%BOD Reduced	%Sed Reduced
	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year	%	%	%	%
Gravelly Brook	26845.3	6716.5	49601.1	1226.6	1880.3	795.9	1102.8	172.3	24965.0	5920.6	48498.3	1054.3	7.0	11.9	2.2	14.0
Little River Frontal - LM	20527.0	3682.1	63751.4	470.1	187.1	83.4	69.9	10.9	20339.9	3598.7	63681.5	459.2	0.9	2.3	0.1	2.3
Peshtigo Dam-PR	23441.2	5771.5	47106.8	1387.8	2855.8	1171.4	2132.5	333.2	20585.4	4600.1	44974.4	1054.6	12.2	20.3	4.5	24.0
Peshtigo R Frontal-LM	48836.2	10721.9	105942.4	800.4	2943.4	1311.6	603.3	94.3	45892.8	9410.3	105339.1	706.1	6.0	12.2	0.6	11.8
Potato Rapids Dam	56550.7	12252.3	115935.1	1765.8	4343.0	1718.6	1803.0	281.7	52207.7	10533.7	114132.1	1484.1	7.7	14.0	1.6	16.0
Thomas Slough	110532.0	24673.1	210410.3	1391.3	0.0	0.0	0.0	0.0	110532.0	24673.1	210410.3	1391.3	0.0	0.0	0.0	0.0
Trout Creek	125169.1	29267.6	226145.5	3373.2	27191.9	10729.9	9002.1	1406.6	97977.2	18537.7	217143.3	1966.7	21.7	36.7	4.0	41.7
Total	411901.5	93085.1	818892.7	10415.3	39401.5	15810.9	14713.7	2299.0	372500.0	77274.2	804179.0	8116.3	9.6	17.0	1.8	22.1

c. Nutrient and sediment load by land uses with BMP (lb/year)

Watershed	Urban				Cropland				Pastureland				Forest				Feedlot			
	N	P	BOD	Sediment	N	P	BOD	Sediment	N	P	BOD	Sediment	N	P	BOD	Sediment	N	P	BOD	Sediment
Gravelly Brook	1954.1	300.8	7531.9	89702.2	20219.3	5090.6	34342.9	1952914.0	1176.8	107.3	3747.8	38352.9	366.6	178.2	894.3	27663.2	1248.3	243.7	1981.4	0.0
Little River Fro	13177.5	2018.7	49882.3	606729.0	5350.7	1262.4	9129.0	269267.7	1037.4	85.6	3340.3	15681.5	273.3	131.7	661.9	26669.2	501.0	100.2	667.9	0.0
Peshtigo Dam	2863.3	438.6	10838.6	131832.7	14702.8	3663.6	26198.4	1872247.5	1662.0	157.7	5268.4	66567.2	287.3	136.6	687.5	38604.6	1070.0	203.6	1981.4	0.0
Peshtigo R Fr	10519.0	1611.4	39818.8	484324.6	29725.8	6847.1	50075.4	817024.7	3452.2	279.9	11135.2	42257.0	845.9	410.3	2059.7	68603.0	1349.9	261.5	2249.9	0.0
Potato Rapids	3723.0	573.0	14349.9	170901.6	31689.5	7760.4	53790.7	2441611.3	11515.5	1023.1	36782.4	321466.2	524.2	255.8	1283.2	34242.1	4755.4	921.4	7925.7	0.0
Thomas Sloug	7113.2	1094.9	27417.3	326529.0	85196.3	21545.1	131146.8	2303517.7	14286.8	1135.9	46172.3	129896.5	381.1	186.3	934.4	22753.7	3554.6	710.9	4739.5	0.0
Trout Creek	8494.5	1307.5	32741.3	389934.8	76375.0	15259.4	147573.7	3438320.4	4995.5	415.5	16070.6	82417.8	384.6	188.1	943.4	22632.2	7727.6	1367.2	19814.3	0.0
Total	47844.5	7344.9	182580.2	2199953.9	263259.4	61428.6	452256.9	13094903.3	38126.3	3205.0	122517.1	696639.2	3063.0	1487.1	7464.6	241168.1	20206.8	3808.5	39360.2	0.0

2. Total load by land uses (with BMP)

Sources	N Load (lb/yr)	P Load (lb/yr)	BOD Load (lb/yr)	Sediment Load (t/yr)
Urban	47844.46	7344.90	182580.17	1099.98
Cropland	263259.43	61428.60	452256.89	6547.45
Pastureland	38126.28	3205.00	122517.14	348.32
Forest	3063.00	1487.12	7464.56	120.58
Feedlots	20206.80	3808.52	39360.24	0.00
User Defined	0.00	0.00	0.00	0.00
Septic	0.00	0.00	0.00	0.00
Gully	0.00	0.00	0.00	0.00
Streambank	0.00	0.00	0.00	0.00
Groundwater	0.00	0.00	0.00	0.00
Total	372499.97	77274.15	804178.99	8116.33

Figure 4-4 Estimated Post-Project Pollution Reductions (Plan Element 2)

Total Load This is the summary of annual nutrient and sediment load for each subwatershed. This sheet is initially protected.

1. Total load by subwatershed(s)

Watershed	N Load (no BMP)	P Load (no BMP)	BOD Load (no BMP)	Sediment Load (no BMP)	N Reduction	P Reduction	BOD Reduction	Sediment Reduction	N Load (with BMP)	P Load (with BMP)	BOD (with BMP)	Sediment Load (with BMP)	%N Reduced	%P Reduced	%BOD Reduced	%Sed Reduced
	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year	lb/year	lb/year	lb/year	t/year	%	%	%	%
Gravelly Brook	22373.9	5430.6	43653.1	1226.6	6022.6	2298.9	3859.9	603.1	16351.2	3131.7	39793.3	623.5	26.9	42.3	8.8	49.2
Little River Frontal - LM	21396.3	3968.9	66530.4	470.1	1778.4	689.6	489.0	76.4	19617.9	3279.3	66041.3	393.7	8.3	17.4	0.7	16.3
Peshtigo Dam-PR	18867.0	4280.8	40026.4	880.1	4613.6	1699.5	2558.9	399.8	14253.4	2581.3	37467.5	480.3	24.5	39.7	6.4	45.4
Peshtigo R Frontal-LM	41155.1	8587.9	96641.5	800.4	6988.6	2780.3	1689.4	264.0	34166.5	5807.6	94952.1	536.4	17.0	32.4	1.7	33.0
Potato Rapids Dam	49676.7	10124.4	106801.9	1765.8	12245.3	4136.4	5048.5	788.8	37431.4	5988.1	101753.4	977.0	24.7	40.9	4.7	44.7
Thomas Slough	110651.4	24719.9	210897.8	1391.3	2132.8	479.9	0.0	0.0	108518.6	24240.0	210897.8	1391.3	1.9	1.9	0.0	0.0
Trout Creek	118837.9	26933.1	218054.6	3373.2	41328.6	14611.5	12753.0	1992.7	77509.3	12321.6	205301.6	1380.6	34.8	54.3	5.8	59.1
Total	382958.2	84045.6	782605.7	9907.6	75110.0	26696.1	26398.8	4124.8	307848.2	57349.5	756206.9	5782.8	19.6	31.8	3.4	41.6

c. Nutrient and sediment load by land uses with BMP (lb/year)

Watershed	Urban				Cropland				Pastureland				Forest				Feedlot			
	N	P	BOD	Sediment	N	P	BOD	Sediment	N	P	BOD	Sediment	N	P	BOD	Sediment	N	P	BOD	Sediment
Gravelly Brool	1954.1	300.8	7531.9	89702.2	11911.3	2388.8	24465.9	1091334.3	1176.8	107.3	3747.8	38352.9	366.6	178.2	894.3	27663.2	927.1	150.6	3090.2	0.0
Little River Frc	13177.5	2018.7	49882.3	606729.0	4228.1	761.8	8709.9	138272.6	1037.4	85.6	3340.3	15681.5	273.3	131.7	661.9	26669.2	312.5	50.8	1041.7	0.0
Peshtigo Dam	2863.3	438.6	10838.6	131832.7	8469.2	1680.3	17401.2	723512.6	1662.0	157.7	5268.4	66567.2	287.3	136.6	687.5	38604.6	927.1	150.6	3090.2	0.0
Peshtigo R Fr	10519.0	1611.4	39818.8	484324.6	17937.1	3194.1	36961.1	477645.2	3452.2	279.9	11135.2	42257.0	845.9	410.3	2059.7	68603.0	1052.7	171.1	3508.8	0.0
Potato Rapids	3723.0	573.0	14349.9	170901.6	17928.8	3521.1	36847.7	1427403.5	11515.5	1023.1	36782.4	321466.2	524.2	255.8	1283.2	34242.1	3708.2	602.6	12360.7	0.0
Thomas Sloug	7113.2	1094.9	27417.3	326529.0	85196.3	21545.1	131146.8	2303517.7	14286.8	1135.9	46172.3	129896.5	381.1	186.3	934.4	22753.7	1421.8	231.0	4739.5	0.0
Trout Creek	8494.5	1307.5	32741.3	389934.8	56988.9	9468.5	124005.7	2266165.7	4995.5	415.5	16070.6	82417.8	384.6	188.1	943.4	22632.2	6489.4	880.7	30901.7	0.0
Total	47844.5	7344.9	182580.2	2199953.9	202659.7	42559.5	379538.3	8427851.6	38126.3	3205.0	122517.1	696639.2	3063.0	1487.1	7464.6	241168.1	14838.7	2237.5	58732.7	0.0

2. Total load by land uses (with BMP)

Sources	N Load (lb/yr)	P Load (lb/yr)	BOD Load (lb/yr)	Sediment Load (t/yr)
Urban	47844.46	7344.90	182580.17	1099.98
Cropland	202659.71	42559.53	379538.27	4213.93
Pastureland	38126.28	3205.00	122517.14	348.32
Forest	3063.00	1487.12	7464.56	120.58
Feedlots	14838.65	2237.46	58732.68	0.00
User Defined	0.00	0.00	0.00	0.00
Septic	1316.11	515.48	5374.13	0.00
Gully	0.00	0.00	0.00	0.00
Streambank	0.00	0.00	0.00	0.00
Groundwater	0.00	0.00	0.00	0.00
Total	307848.21	57349.50	756206.95	5782.81

As stated earlier, this project builds on significant progress, especially in the Trout Creek sub-watershed and sub-watersheds (Left Foot Creek and Peterman Brook) removed from the LPR watershed HUC10. In the figures below, the P Load (with BMP) and Sediment Load (with BMP) from Figure 4-3 are compared to the P Load (with BMP) and Sediment Load (with BMP) from Figure 4-4. These numbers account for the planned practices for both croplands and animal feed lot areas within each HUC 12 sub-watershed.

Figure 4-5 Estimated Reductions in Phosphorus Loads from BMP Installations

HUC 12	Cropland Acres	Pre-Project P lb/year	Post-Project P lb/year	P Reduction lb/year	% P Reduced
Gravelly Brook	1,699	5,334.3	2,539.4	2,794.9	52.4%
Little R. Frontal -LM	1,046	1,362.6	812.6	550.1	40.4%
Peshtigo Dam – Peshtigo R.	1,908	3,867.2	1,831.0	2,036.2	52.7%
Peshtigo R- Frontal LM	4,482	7,108.7	3,365.1	3,743.6	52.7%
Potato Rapids Dam	2,615	8,681.7	4,123.7	4,558.0	52.5%
Thomas Slough	6,643	22,256.0	21,776.1	479.9	2.2%
Trout Creek	9,457	16,626.6	10,349.2	6,277.4	37.8%
Total	27,849	65,237.1	44,797.0	20,440.1	31.3%

Figure 4-6 Estimated Reductions in Sediment Loads from BMP Installations

HUC 12	Cropland Acres	Pre-Project Sediment t/year	Post-Project Sediment t/year	Sediment Reduction t/year	% Sediment Reduced
Gravelly Brook	1,699	976.5	545.7	430.8	44.1%
Little R. Frontal -LM	1,046	134.6	69.1	65.5	48.6%
Peshtigo Dam – Peshtigo R.	1,908	936.1	361.8	574.4	61.4%
Peshtigo R- Frontal LM	4,482	408.5	238.8	169.7	41.5%
Potato Rapids Dam	2,615	1,220.8	713.7	507.1	41.5%
Thomas Slough	6,643	1,151.8	1,151.8	0.0	0.0%
Trout Creek	9,457	1,719.2	1,133.1	586.1	34.1%
Total	27,849	6,547.5	4,213.9	2,333.5	35.6%

The STEPL model estimates Pre-Project agricultural lands and practices will generate a total of 65,237.1 pounds of Phosphorus from 27,849 acres of cropland and 12 acres of feedlots. This equates to Phosphorus loads of approximately 2.34 pounds of per acre. For sediment, the same Pre-Project acres will generate a load of 0.23 Tons per acre.

Upon full BMP installation, the total cropland and feedlot phosphorus load would be reduced by 20,440.1 pounds, equating to an estimated 1.6 pounds per acre. For sediment, the estimated Post-Project load per acre is 0.15 Tons per acre. Obviously it is not realistic to assume BMP's will be applied to every cropland acre in the watershed. In Figure 5-4, Phosphorus and Sediment reductions are estimated for 16,000 total acres

(Approx. 65% of all watershed cropland). It is expected that implementing these practices and achieving the corresponding pollutant load reductions will help ensure the LPR and its tributaries will met the Phosphorus standard of 0.075 milligrams per liter. See Chapter 9. Figure 9-1 for an over view of recent LWCD WQ and WDNR aquatic habitat monitoring results for several HUC 12 sub-watersheds within the LPR watershed.

Chapter 5. Planned Activities, Milestones and Time Frames

Due to a paucity of water quality, biotic, land use, or specific farm data for Marinette County, the early years of watershed plan implementation (See figure 5-1) will focus on gathering data, filling in knowledge gaps and putting new assessment and modelling tools to use. Once obtained and analyzed, these data will inform and prioritize future application of phosphorus and sediment reduction practices, educational programming, and capacity building. Full plan implementation will depend on acquisition of resources not currently at the disposal of Marinette County or the WDNR.

Although the Lower Peshtigo River Watershed Management Plan focuses upon agricultural causes and sources of pollution, planned activities include general environmental education, habitat restoration, invasive species control, etc. Emphasis has long been placed on reducing loads of phosphorus and sediment to streams while essentially ignoring other stressors and impairments. In the final analysis, it makes little difference to a fish **WHY** it can't live in a particular stream, whether it is low dissolved oxygen, poor habitat, water that is too warm, lack of water, competition from exotic species, turbidity, extreme flashiness, or whatever. A healthy stream has **ALL** the food, shelter, water, and space fish and other aquatic organisms need to live and reproduce. Providing **ALL** those components should be the goal for any management plan.

Marinette County has focused on ending the winter spreading of manure for almost two decades. This plan will continue that effort in the Lower Peshtigo River Watershed. The farm inventory conducted for this plan identified approximately 40 farms large enough to be likely candidates to install cropland and feed lot practices for water quality. Twenty-five of these farms have already installed practices. Of the remaining fifteen, some may cease operation. However, if current agricultural land use trends continue, the cropland acreage in the LPR watershed will only shrink slightly and the cattle numbers will remain roughly the same. As this plan is implemented, it will need to be amended to reflect these realities.

In the long term, general environmental education may be the most critical work in the plan. Information and education is discussed in detail in Chapter 7.

An additional consideration in developing this work plan is that the same flexibility and responsiveness that make the LWCD relevant in Marinette County make it very difficult to forecast what the workload will be beyond next year. The next environmental crisis or issue may take the LWCD in an entirely different direction. The same is true if new resources become available to deal with an existing problem.

Figure 5-1. 2016 – 2026 Planned Activities and Schedule (Plan Elements 1, 2 and 9)					
Goal	Activity		LWCD Partners and/or Funding Sources	Milestone(s)	Time Frame
Learn more about the biota, environmental health, and human health risks in the watershed	Complete and analyze the phosphorus, aquatic insect, and fishery data gathered during the creation of this plan and then amend plan objectives and activities to reflect findings.		WDNR	Monitoring Report	2018
	Fully utilize the Healthy Watershed Assessment tool to predict impaired catchments and possibly prescribe treatments		WDNR, NRCS	Final Report	2019
	Run the SNAP Plus model for the Trout Creek HUC12 using known or representative crop rotations and soil P concentrations		DNR,DATCP, UWEX	Load Reduction Est.	2020
	When the LiDAR data becomes available, utilize the EVAAL model to predict portions of the watershed at risk for excessive soil erosion		WDNR, NRCS	Erosion Prediction Map	Trout Creek 2019
	Expand the knowledge base of fish populations in watershed streams and the streams highest potential use		WDNR	Stream fishery reports	2020
	Survey the watershed for fish passage issues		USFWS, WDNR	Map, GIS Layer Created	2022
	Locate best sites to restore Northern Pike spawning habitat in the Little River and Peshtigo R. Frontal LM HUC12s				
	Identify threats to future conditions such as Exotic Species, development patterns, etc.		As appropriate	Updated GIS and website, NWJ articles	Ongoing
	Map groundwater quality in the watershed	Coordinate a volunteer homeowner funded private well sampling campaign in the watershed; further investigate areas where Nitrates, etc. exceed state standards	UW – Stevens Point, WDNR	Map Created	2019
		Perform targeted investigations of areas with wells known to exceed state standards for nitrates, bacteria, etc.		Map Created	When resources become available
	Locate all abandoned wells in the watershed		NRCS	Map Created	2021

Figure 5-2. 2016 – 2026 Planned Activities and Schedule (Plan Elements 3, 6, 7 and 9)				
Goal	Activity	LWCD Partners and/or Funding Sources	Milestone(s)	Time Frame
Reduce impacts of nonpoint source pollution on human health	Properly decommission abandoned wells	UWEX, WDNR, NRCS	Percentage of abandoned wells decommissioned	50% by 2023, 90% by 2026
	Close unused in-ground manure storage facilities	WDNR, DATCP, NRCS	Two per year	2017 to 2026
	Promote and administer Clean Sweeps to properly dispose of agricultural and home chemicals	DATCP	Clean Sweeps Held	2017, 2021, 2024
	Use the results of well sample analysis to guide future efforts	UWEX, Local NGO's		Ongoing
	Audit implementation of nutrient management plans	DNR, DATCP, UWEX	Audit 10 plans per year	Annually

Figure 5-3. 2016 – 2026 Planned Activities and Schedule (Plan Element 6 and 7)					
Goal	Activity		LWCD Partners and/or Funding Sources	Milestone(s)	Time Frame
Deal with other environmental stressors in the watershed	Prevention, control and eradication of Exotic Invasive Species		WDNR, WRISC, NRCS, Local Gov'ts	One aquatic, and one terrestrial project per year	2016 to 2026
	Prevent and/or repair fish passage problems	Proper Culvert Installations	USFWS, Local Gov'ts	Installation Workshop	2019, 2023
		Repair blockages		One per year	As resources are obtained
	Restore wetland habitat, especially Northern Pike spawning and nursery areas		WDNR, NRCS, USFWS, GLRI	One project per year	As willing landowners and funding are found

Figure 5-4. 2016 – 2026 Planned Activities and Schedule (Plan Elements 3, 6, 7, 8, and 9)						
Goal	Activity		LWCD Partners and/or Funding Sources	Milestone(s)	Time Frame	Estimated Annual Phosphorus and Sediment Reductions
Minimize the risk of acute manure and runoff events and the amount of Phosphorus reaching the Lower Peshtigo River	End winter spreading of manure in the watershed	Apply for a Large Scale Non-TMDL TRM Grant	WDNR, DATCP, NRCS	Approved Application	2017 or when approved	Reductions identified in 9 Element watershed plan
		Install manure storage Facilities		15 Animal Waste Systems	2 Farms Per Year[1]	12,216 lbs. P[3]
		Capture and store contaminated farmstead runoff				1,494 lbs. P
		Implement fully compliant 590 standard nutrient management plans		4,000 ac.	2022[2]	2,960 lbs. P[4] 320 Tons Sed.[5]
				4,000 ac.	2026[2]	2,960 lbs. P 320 Tons Sed.
	Complete and then regularly update soil phosphorus level maps for watershed croplands			Map and revisions	2020, then annually[2]	
	Reduce the impacts of manure hauling on local roads and the risk of spills		Local Gov'ts	Mitigation projects; local ords	Ongoing	
	Enforce the Marinette County Agricultural Performance Standards and Animal Waste Management Ordinance			NA	Ongoing	
	Operation and maintenance inspections		NRCS, WDNR	Visit each farm with installed practices very 3rd year	2016 to 2026	
	Audit Nutrient Management Plan Implementation		DNR, DATCP, UWEX	Audit 10 plans per year for compliance with 590 NM Std.	Annually[2]	

Note: [1] Dependent on the level of cost sharing available. [2] Dependent on having additional staffing resources. See Figure 6-2 for an estimate.
[3] No manure storage facility contents will be winter spread on crop fields. Based on discovery farms estimates of 1.6 lbs. P/acre leaving crop fields winter spread with manure times the average sized commercial farm in the watershed.

[4] Estimated acres X (Pre Project load – Post project P load from page 51) = 4,000 X (2.34 lb P /ac - 1.60 lb P/ac) = 5,920 Lbs; the STEPL estimated reductions in Phosphorus due to BMP installations.
[5] Estimated acres X (Pre Project load – Post project sediment load from page 51) = 4,000 X (.23 ton Sed /ac - .15 ton Sed/ac) = 320 Tons; the STEPL estimated reductions in Sediment due to BMP installations.
[6]Estimates 15 farms times the average of 99.6 lbs P leaving a feedlot/barnyard without BMPs. Average is from 15 BARNY results from watershed farms

Figure 5-5. 2016 – 2026 Planned Activities and Schedule (Plan Element 5, 7, and 8)					
Goal	Target Audience	Activity	Outcomes	LWCD Partners	Time Frame
Provide information in support of plan goals; make the connection between land use and environmental quality	General Public (Including Producers)	Regular articles about the project in the Northwoods Journal	Two to four articles per year	UWEX, WDNR, NRCS	2016 to 2026
		Use of social media to improve outreach capabilities	Build and maintain Facebook page	WLW	2016 then regular maintenance
		Use of Harmony Arboretum for educational programing	One event per year	UWEX, Local NGO's	2017 to 2026
		Advertise well sampling for homeowners	Up to 150 wells per year sampled	WDNR, DATCP, USFWS	2017 to 2026
		Seek properties suitable for habitat restorations	One project per year		
Improved communication with and between producers; publicize progress and increase producer and landowner acceptance; improve BMP operation and maintenance	Producers	Direct mailing to known producers active in the watershed. If a large scale TRM grant is obtained for the watershed, an additional mailing will be made	Initial mailing and then as appropriate	NRCS, UWEX	2016 and when new grants or resources are found
		Biannual nutrient management workshops	One workshop every two years	DATCP, UWEX	2018, 20, 22, 24, 26
	Producers, local Gov'ts	Tour farms that have implemented practices	One tour per year;	NRCS, UWEX	Annually 2017 - 2022

Chapter 6. Technical and Financial Assistance Needed, Costs, and Authorities

2016 Work Plan Budget

Marinette County currently has approximately 1.2 FTE's working on agriculture county-wide. Although Marinette County has and enforces its own Agricultural Performance Standards and Animal Waste Ordinance, we are almost entirely dependent on obtaining external funding for installation and implementation of BMP's on the land. Our focus remains on ending winter spreading of manure. This can only be accomplished by installing manure storage facilities with the capacity to bridge the frozen and show covered ground season. Furthermore, our sandy soils require the use of concrete watertight facilities, the most expensive option.

Our largest source of BMP funding is the WDNR Targeted Runoff Management program. This is a competitive program and although Marinette County had more than fifty successful applications in the past, future results are obviously not guaranteed. On a positive note, the increased data and knowledge garnered in the watershed should provide a solid base of information in support of a Large Scale Non-TMDL TRM grant application.

Recently in Wisconsin there has been a great deal of concern and discussion about efficacy of nutrient management plans, which are only as effective as their implementation. To ensure the value of nutrient management plans, it is necessary to audit their implementation, issue compliance or noncompliance determinations per NR151 and then provide follow-up education to landowners.

The agricultural areas of Marinette County are also quite susceptible to ground water contamination. However, there has never been an extensive, systematic study of groundwater conducted anywhere in the county to determine if problems exist. The Lower Peshtigo River Watershed, due to the juxtaposition agriculture and rural residential land use is an excellent candidate for the first study. See Figure 6-2 for additional details.

Putting the actions described above into practice will take significant external resources. Figure 6-1 below describes the current external funding sources for 2016.

Figure 6-1. County-wide External Funding Anticipated in 2016

Program	External Funding Amount	Source	Notes
Targeted Runoff Management	$150,000?	WDNR (TRM)	The TRM program limits individual counties to no more than 10% of the total cost sharing available. Typically at least five project applications are developed for each grant cycle. The successful 2016 applications have not been announced yet.
LWRM Plan Implementation	$57,000 $55,000	DATCP (Bond) DATCP (SEG)	Reflects the amount of cost share funding available for the entire county, not the amount needed. Bonding is for constructed practices. SEG is for nutrient management planning.
Environmental Quality Incentives Program	??	NRCS	It is not known at this time how much EQIP Cost sharing will be available for 2016 or how it will be targeted.
External Funding Total	$252,000		

Figure 6-2. Funding needs for full implementation (Plan Elements 4 & 9)

Plan Element	What needs to be done	Estimated Resources Needed per Year[1]	Source
Existing Staff working on Agricultural Non-Point Source pollution	Applying for grants, administering existing programs, designing and supervising BMP's installation, O&M and compliance checks	$115,087	DATCP, LWCD
End winter spreading of Manure	Install manure storage facilities and associated practices	$400,000 in cost sharing	WDNR, NRCS, DATCP, GLRI, LWCD
Ensure compliance with new NRCS 590 standard	All watershed crop land under fully implemented nutrient management plans	$22K cost sharing; add at least a half time ($54 - $107K) nutrient management planner to staff	NRCS, DATCP, LWCD
Ensure farms are not a pollution source or safety risk when operations cease	Properly: abandon hard practices; decommission abandoned wells;	$15,000	DATCP, NRCS, LWCD
	Participate in Clean Sweeps as offered	$12,000	DATCP, LWCD
Investigate individual catchments given low scores by the Healthy Watershed Assessment (HWA) Tool	Verify conditions are as modeled; determine corrective measures needed	Completed by current staff	DATCP, LWCD
Habitat protection and restoration	Repair fish passage issues	$15,000	USFWS, ??
	Restore habitat	$10,000	NRCS, WDNR
Repair impaired catchments identified by the HWA	Investigation, obtain resources; train staff if necessary; implement prescribed actions	$5,000 - $30,000	WDNR, DATCP, USFWS, GLRI, LWCD, ???
Human health protection	Systematically monitor private wells and map data	$2,000 - $5,000	Landowners, LWCD, UWSP, Local Gov'ts
Run EVAAL assessment on the watershed	Incorporate LiDAR into County GIS, train staff on EVAAL, gather additional data as required	$10,000 for three years	DNR, LWCD
All education efforts	NWJ, direct mailings, workshops, website, social media	$4,000	LWCD, DATCP, ??
Incorporate 2014 and 15 monitoring data into plan implementation	Complete data gathering; obtain results; organize and analyze data	Completed by current staff	DNR, LWCD
Surface and ground water monitoring	Phosphorus monitoring, aquatic insect, and fish IBI's, well water testing	$11,000	DNR, LWCD
	Totals	$675K to $756K for first year; there should be a significant drop in costs after year three as initial mapping, auditing, modelling, etc. are completed	

[1] Estimates are 2015 dollars and not adjusted for inflation.

State and local regulations

Wis. Stats. CHAPTER 281.16 Water and Sewage (3) NONPOINT SOURCES THAT ARE AGRICULTURAL (a) The department of natural resources, in consultation with the department of agriculture, trade, and consumer protection promulgate rules prescribing performance standards and prohibitions for agricultural facilities and practices that are nonpoint sources.

Wis. Admin. Code. DEPARTMENT OF NATURAL RESOURCES CHAPTER (*May 2013*) NR151Subchapter II 151.01 Purpose. The purpose of this subchapter is to prescribe performance standards and prohibitions in accordance with the implementation and enforcement procedures contained in ss. NR151.09 and 151.095 for agricultural facilities, operations and practices.

Wis. Admin. Code. DEPARTMENT OF AGRICULTURE, TRADE AND CONSUMER PROTECTION CHAPTER (*May 2015*) ATCP 50.12 Land and water resource management plan (2) Land and water resource management plan (h) Compliance procedures, including notice, hearing, enforcement and appeal procedures, that will apply if the county takes action against a landowner for failure to implement conservation practices required under this chapter, ch. NR 151 or related local regulations.

MARINETTE COUNTY CODE OF ORDINANCES CHAPTER 21.01 (*December 2003*) Shoreland-Wetland Zoning (3)

For the purpose of promoting the public health, safety, convenience and welfare, this chapter has been established to:

- (a) Further the maintenance of safe and healthful conditions and prevent and control water pollution through:
  - (1) Limiting structures to those areas where soil and geological conditions will provide a safe foundation.
  - (2) Establishing minimum lot sizes to provide adequate area for private sewage disposal facilities.
  - (3) Controlling filling and grading to prevent serious soil erosion problems.
- (b) Protect spawning grounds, fish and aquatic life through:
  - (1) Preserving wetlands and other fish and aquatic habitat.
  - (2) Regulating pollution sources.
  - (3) Controlling shoreline alterations, dredging and lagooning.
- (c) Control building sites, placement of structures and land uses through:
  - (1) Separating conflicting land uses.
  - (2) Prohibiting certain uses detrimental to the shoreland area.
  - (3) Setting minimum lot sizes and widths.
  - (4) Regulating side yards and building setbacks from waterways.
  - (5) Allow only limited lifetime expansion to non-conforming structures.
- (d) Preserve shore cover and natural beauty through:
  - (1) Restricting the removal of natural shoreland cover.
  - (2) Preventing shoreline encroachment by structures.

(3) Controlling shoreland excavation and other earth moving activities.
(4) Regulating the use and placement of boathouses and other structures

MARINETTE COUNTY CODE OF ORDINANCES CHAPTER 20.02 (*May 2007*) NONMETALLIC MINING RECLAMATION ORDINANCE Purpose. The purpose of this chapter is to establish a local program to ensure the effective reclamation of nonmetallic mining sites on which mining takes place in the County of Marinette after the effective date of this chapter, in compliance with Chapter NR135, Wisconsin Administrative Code and Subchapter I of Chapter 295, Wisconsin Statutes.

MARINETTE COUNTY CODE OF ORDINANCES CHAPTER 18.01 (*May 2006*) AGRICULTURAL PERFORMANCE STANDARDS AND ANIMAL WASTE MANAGEMENT (3)

The purpose of this chapter is to regulate agricultural practices and the management of animal waste to:
(a) Ensure the proper location, design, installation, use and abandonment of animal feedlots and animal waste storage facilities.
(b) Protect the safety, welfare, environmental quality and aesthetic values of Marinette County.
(c) Prevent the deliberate mismanagement of manure.
(d) Establish a procedure for the permitting of animal feedlots and waste storage facilities.
(e) Achieve a soil erosion rate on all croplands equal to, or less than, the Tolerable (T) rate established for that soil.
(f) Minimize conflicts between agricultural operations and municipalities, non-farm landowners and visitors.
(g) Protect the future viability of agriculture in Marinette County.

MARINETTE COUNTY CODE OF ORDINANCES Chapter 25.04 (*Dec 2006*) CONSTRUCTION AND EFFECT OF ORDINANCES (4) Ordinance enforcement by citation for Chapter 18 and 21 Marinette County Code. This Ordinance identifies the citation method of enforcement specified in ' 66.119 Wis. Stats.

MARINETTE COUNTY CODE OF ORDINANCES Chapter 23.01 (*June 2003*) LAND DIVISION AND SUBDIVISION REGULATIONS (2) PURPOSE AND INTENT. The purpose of the code is to promote the public health, safety and general welfare of the residents and landowners of the County, to further the orderly layout and use of land, and to secure safety from fire, panic and other dangers. This ordinance will be adjusted in 2011 to comply with the revisions to NR115 promulgated in January 2010.

MARINETTE COUNTY CODE OF ORDINANCES Chapter 15.02 (*Dec 2008*) PRIVATE SEWAGE SYSTEMS The purpose of this chapter is to protect and promote the health, safety, prosperity, aesthetics and general welfare of the people and communities within Marinette County. The general intent of this chapter is to regulate the location, construction, installation, alteration, maintenance and use of onsite waste disposal systems so as to protect the health of residents and transients and to secure safety from disease, nuisance and pestilence and for the protection of the groundwater resource.

MARINETTE COUNTY CODE OF ORDINANCES Chapter 17.02 (*Jun 2005*) ZONING CODE The provisions of this chapter are intended to encourage the use of lands and natural resources in the County in accordance with their character and adaptability to promote orderly development; secure safety to life and property; protect highways from economic suffocation by encroaching uses; preserve land values; encourage and promote public health, morals, safety and general welfare; regulating, restricting and determining the areas within which agriculture, forestry and recreation may be conducted; and establishing districts which are deemed best suited to carry out such purposes outside of the limits of incorporated villages and cities in accordance with the provisions of '59.97, Wis. Stats.

The full texts of the Marinette County Ordinances listed above may be viewed at www.marinettecounty.com.

Under subchapter III of NR 216, Wis. Adm. Code, a notice of intent shall be filed with the DNR by any landowner who disturbs one or more acres of land. This disturbance can create a point source discharge of storm water from the construction site to waters of the state and is therefore regulated by DNR. Agriculture is exempt from this requirement for activities such as planting, growing, cultivating and harvesting of crops for human or livestock consumption and pasturing or yarding of livestock as well as sod farms and tree nurseries. Agriculture is not exempt from the requirement to submit a notice of intent for one or more acres of land disturbance for the construction of structures such as barns, manure storage facilities or barnyard runoff control systems. (See s. NR 216.42(2), Wis. Adm. Code.) Furthermore, construction of an agricultural building or facility must follow an erosion and sediment control plan consistent with s. NR 216.46, Wis. Adm. Code and including meeting the performance standards of s. NR 151.11, Wis. Adm. Code.

An agricultural building or facility is not required to meet the post-construction performance standards of NR 151.12, Wis. Admin. Code. (07/31/08 MAL)

Agricultural Performance Standards and Prohibitions Implementation Strategy

Marinette County enforces a number of local ordinances to protect the environment, public health and safety, local economy, etc. A main focus of the Land and Water Conservation Division is to implement the NR151 Agricultural Standards and Prohibitions. See figure 1-1 for an overview of the Agricultural Standards and associated best management practices. Below are listed the compliance procedures for our NR151 implementation strategy.

- Enforce Chapter 18 of the Marinette County Code of Ordinances: AGRICULTURAL PERFORMANCE STANDARDS AND ANIMAL WASTE MANAGEMENT
- When the relationship of workload to resources becomes favorable, prioritize farms for installation of BMPs list based upon ATCP 50.12(2)(f) and other state and local criteria.
- Inform and educate landowners/operators about performance standards and prohibitions
- Conduct compliance status surveys, including on-site visits, for cropland and livestock facilities and convey compliance status and maintenance responsibility to landowners/operators
- Discuss with landowners/operators the best management practices needed to achieve compliance with performance standards and prohibitions
- Seek financial assistance for landowners/operators to achieve compliance with performance standards and prohibitions
- Develop cost-share agreements with landowners/operators and provide them with technical assistance to achieve compliance with performance standards & prohibitions
- Assist the Department of Natural Resources with stepped enforcement and issuance of notices under NR 151.09 and NR 151.095.
- Track compliance status of cropland and livestock facilities and provide compliance status information to the Department of Natural Resources upon request. This includes notifying WDNR when the landowner/operator does not comply with a notice issued under NR 151.09 or NR 151.095.
- When local ordinances do not apply, refer cases of noncompliance to the local district attorney when requested by the Department of Natural Resources.
- Collect, evaluate for accuracy and submit annual reporting information on performance standards implementation to DNR and DATCP.
- Appeals process, compliance provisions and entire text of Marinette County Ordinances can be found at the Marinette County Web site www.marinettecounty.com.

Chapter 7. Information and Education Strategy

Information and education (I&E) are critical to reaching each resource goal of this plan. Success in meeting resource goals requires many county individuals to change the way they treat land and water resources. Individuals will not make these changes unless they understand the importance of water resources, the ways to protect those resources, and are aware of available assistance. The Marinette County I&E strategy is based on a quote from a Senegalese ecologist.

In the end we will conserve only what we Love.
We will love only what we understand.
We will understand only what we are taught.

\- *Baba Dioum*

Figure 5-5 lists the goals and activities specific to the implementation of this plan. In this chapter a general I&E strategy has been detailed. The strategy also lists important messages and recommended activities to deliver those messages. New messages and activities may be developed as the plan is implemented. Implementation of the I&E strategy will be evaluated and modified along with other components of the plan each year.

In addition to programs, messages, and strategies to build general awareness and appreciation of nature, the LWCD environmental education program works to support and promote: the implementation and installation of Best Management Practices for water quality, the regulations that protect the health safety and welfare of Marinette County citizens, and any other programs offered by the LWCD or other Marinette County departments.

The I&E strategy focuses on four main elements.

Knowledge: People must understand how land use affects water quality and quality of life. They need to be given the information necessary to understand the cause and effect of land use decisions on the environment and become good stewards of our land and water resources.

Skills: People need skills to correct runoff pollution problems, protect and enhance habitat, and prevent the spread of exotic invasive species. They must be supported with tools, resources, equipment, and expertise.

Motivation: Some individuals need moral or financial incentives to change their actions. They need to see what is in it for them in the form of higher property values, more fish and game, better quality of life, etc.

Feedback: To stay excited about their efforts, people need positive, ongoing feedback. Positive feedback (both from and to citizens) will maintain momentum and increase participation. Recognition is a key component of feedback. Also, follow up monitoring of installed projects and habitat restorations to measure results for publication.

Audience

I&E program components reach all age groups that live and work in Marinette County.

1. **Non-Farm Audience:** Landowners that live adjacent to a watershed farm, river, or stream. Also, seasonal and short term visitors that come to recreate on watershed lands and water bodies.

2. **Agricultural Audience:** Agricultural and horticultural producers, cooperatives, agricultural consultants, and cooperating agencies.

3. **Institutional Audience:** Local government, sporting and environmental groups, business associations, chamber of commerce, news media, tourism groups, service clubs, and churches.

4. **Commercial Audience**: Contractors, developers, realtors, well drillers, cooperatives, stores and shops.

5. **Urban Audience:** Permanent and seasonal residents of cities, villages, or concentrated rural areas (subdivisions).

6. **Educational Audience:** Teachers, students, school administrators.

Implementation Team

The education strategy was developed by Marinette County Land Information Department staff with assistance from the Marinette County UW-Extension (UWEX), WDNR, and NRCS.

The Marinette County LWCD will take lead responsibility for the implementation of the information and education strategy. UWEX and WDNR provide supporting assistance. The LWCD will work with and seek additional support from local units of government, sporting and environmental organizations, lake districts and associations, and other community groups and businesses.

Information & Education Goals

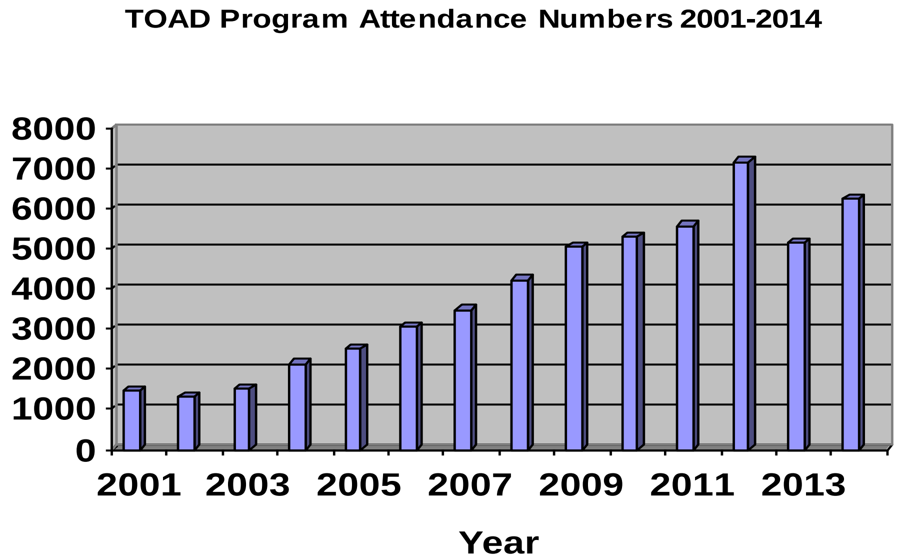
While not specific to the implementation of this plan, the following goals from the Marinette County Land and Water Resource Management Plan are critical to the long term success of this plan and all the conservation efforts of Marinette County. Marinette County residents and visitors of all ages must be constantly reminded about the role they play in the environment and their effect on the natural world. They must be given a greater understanding and appreciation of nature.

The LWCD began offering the Teaching Outdoor Awareness and Discovery (TOAD) program in 2001. The TOAD program brings together an extensive array of outdoor equipment that can be brought to schools or field locations for the study of water quality, forestry, aquatic insects, birdwatching, etc. The TOAD program also includes our collection of mammal *Skins and Skulls, Birds-on-a Stick,* and trailered collection of canoes and paddling equipment.

The TOAD program is an excellent way to let people know about the wonders of nature and that they can have as much fun outside as inside. Children that know and love nature, rather than fear it, grow up to make environmentally friendly decisions. Since its creation, the TOAD program has continued to grow in popularity and expand in scope. Figure 7-1 below shows the growth in the TOAD program.

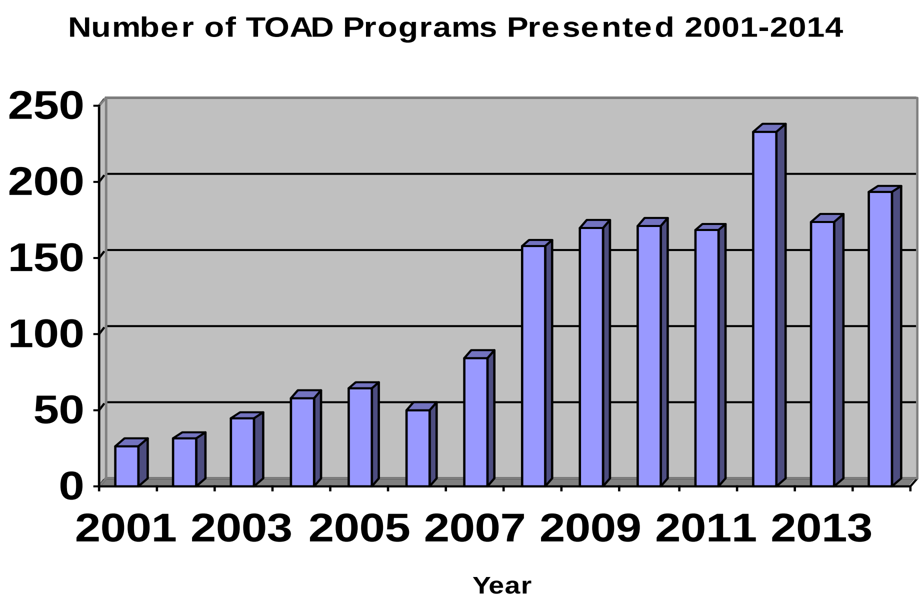
While TOAD is a county-wide program, Marinette County's two largest school districts are in the LPRW. Harmony Arboretum and the Peshtigo Harbor Wildlife Area, sites of many TOAD programs, are also in the watershed. These are all useful resources for delivering the message about reducing nonpoint source pollution and the environmental benefits provided.

Figure 7-1. TOAD Attendance & Program Numbers



2001 – 1461
2002 – 1307
2003 – 1496
2004 - 2131
2005 – 2507
2006 – 3053
2007 – 3482
2008 – 4217
2009 – 5058
2010 – 5308
2011 – 5565
2012 – 7,155
2013 – 5,139
2014 – 6,427

54,306 = cumulative total participants through 2014



2001 – 26
2002 – 31
2003 – 44
2004 – 58
2005 – 64
2006 – 50
2007 – 84
2008 – 157
2009 – 170
2010 – 171
2011 – 168
2012 – 233
2013 – 174
2014 – 193

1,623 = cumulative total programs through 2014

Marinette County also uses the Northwoods Journal and the county website to promote and publicize departmental initiatives, highlight current issues, and provide general education. The following lays out the overall goals, messages, and rationale for Marinette County's education programming.

Goal #1: Help Marinette County citizens make the connection between land use and environmental quality.

Messages

- Stewardship for Land and Water Resources is everyone's responsibility. What we do on the land affects our water quality.
- Land and water resources are valuable to us in their natural state.
- Nonpoint source pollution is the number one threat to water quality in Marinette County.
- Healthy habitat is the key to flourishing fish and wildlife populations.
- Habitat loss and fragmentation are harming fish and wildlife populations.
- Wetlands provide critical fish and wildlife habitat, protect water quality, and limit flooding.
- Agriculture and environmental stewardship can benefit each other.

Goal #2: Control runoff pollution from riparian areas and forest lands. Increase natural habitat.

In addition to general environmental education, the LWCD will also offer targeted education programming in support of our technical assistance and cost sharing programs, habitat restoration, exotic species control, ordinance enforcement, and whatever new environmental threats materialize.

Messages

- Natural vegetated buffers and BMP's for water quality can improve the quality of life for shoreline property owners.
- Forestry BMP's help preserve water quality while maintaining soil fertility and land values.
- Cost sharing is available for some BMP's.
- The Land & Water Conservation Division and other agencies can provide the tools and training to protect water quality.
- Shoreland Zoning regulations are necessary to protect fish and wildlife habitat and natural scenic beauty.

Goal #3: Control runoff pollution from agricultural lands and increase natural habitat.

Messages

- Best Management Practices (BMPs) help preserve ground and surface water quality while increasing farm efficiency and reducing costs. *Focus will be farmstead practices such as manure storage and barnyard runoff control, manure storage abandonment, and well decommissioning.*
- Agricultural BMP's help preserve water quality while maintaining soil fertility and land values. *Focus will be on nutrient management planning.*
- Cost sharing is available for some BMP's.
- The Land & Water Conservation Division and other agencies can provide the tools and training to protect water quality.
- Agricultural chemicals should be properly disposed of to protect human health
- Abandoned wells are a direct conduit to ground water and should be properly decommissioned to prevent contamination of drinking water

Goal #4: Manage and/or Prevent the Spread of Invasive Exotic Species

High Phosphorus levels improve growing conditions for aquatic invasive species. Because the threat of exotic invasive species is still relatively new, a significant amount of our effort is based on explaining why we should worry about them. Unlike many of our other environmental threats, we also must help the public identify the plants and animals of greatest concern. Many exotic species have native look-a-likes.

Messages

- Invasive exotic species have the ability to invade natural systems and dominate or eliminate native plants and animals.
- Certain exotic species, such as Eurasian Water Milfoil, Phragmites, and Garlic Mustard have become a threat to natural areas in Marinette County.
- Many invasive exotic species on the horizon have the potential to become a threat to the resources of the county.
- Help to manage and prevent the spread of these species is available through the Land Information Department and WDNR.

Chapter 8. Coordination

State and Federal Government

The voluntary components of this plan rely on State and Federal cost share programs. These programs include the NRCS Environmental Quality Incentives; WDNR Targeted Runoff Management, WDNR Lakes, WDNR Aquatic Invasive Species; DATCP Land & Water Resource Management; the US Fish & Wildlife Service Partnership, Wisconsin Coastal Management, and other public and private grant sources.

Continued staffing assistance from DATCP (for day to day operations) and from WDNR, NRCS, UWFWS and other grant sources (for specific projects) are crucial to the success of the plan.

Marinette County staff will design, implement, and oversee the construction of the majority of the Best Management Practices identified in this plan. Engineering assistance and job approval will be coordinated with the DATCP and NRCS area staff. Ordinance enforcement and regulatory compliance with the NR151 Performance Standards and Prohibitions will be coordinated between the Land Information Department and the Marinette County Corporation Counsel.

Educational programming is constantly evaluated to ensure that our messages are consistent with the latest research and data from agencies and academia. We also work with partner agencies to stay current and ensure a consistent interpretation of state and federal codes, statutes, and administrative rules. When necessary or appropriate, DNR will also be included in NR 151 enforcement and compliance.

Local Government

Land use planning, water quality and quantity, invasive species and other issues necessitate working with town and municipal governments. Environmental and other problems do not recognize political boundaries. Additionally, shrinking budgets require us all to seek the most cost effective solution to problems. Therefore, Marinette County will continue to work with local governments on projects of mutual benefit. We will also strive to provide local governments with technical assistance, grant writing help, and capacity building such that all governmental entities within the county are providing the greatest possible level of service to our citizens at least cost.

Marinette County has worked directly with the Cities of Marinette and Peshtigo as well four of the five towns represented in the watershed. Projects have included: lake managements plans, several invasive species control projects, development of outdoor learning sites, comprehensive planning, and storm water management.

Regional Groups

Exotic species also know no boundaries. Working to control their spread and eradicate exotic species where possible necessitates working with entities and agencies outside of Marinette County. It was in recognition of these facts that lead Marinette County to formally join the Wild River Invasive Species Coalition (WRISC) in 2010. WRISC is one of several regional groups formed to battle invasive exotic species though education, prevention, and control. Marinette is one of five Wisconsin and Michigan counties part of the group. Through WRISC, Marinette County has obtained significant resources to deal with a growing problem. The Marinette County LWCD will continue relationships across political boundaries, and seek new relationships, to improve the efficacy of prevention and control activities.

Local Non-Governmental Groups

The Marinette County Land and Water Conservation Division has strong relationships with local environmental and service groups. The Northern Lights Master Gardeners and the Chappee Rapids Chapter of the Audubon Society are active in the watershed. Both groups work at our Harmony Arboretum property, leading their own educational programs and assisting Marinette County staff with others. The Audubon group also works in the Peshtigo Harbor Wildlife Area, leading educational programs and maintaining the wildlife observation deck they built there.

State-Wide Non-Governmental Groups

Marinette County is an active member of Wisconsin Land and Water (WLW), a state wide group representing county Land and Water Conservation Committees. WLW promotes locally led conservation, coordinates a common conservation message on behalf of counties to state and federal legislators, coordinates the professional improvement of member staff and supervisors, and runs the Standards and Oversight Council (SOC). SOC gives counties a voice when technical standards and BMP’s are modified or changed.   WLW helps counties on issues that cross county borders and builds coalitions in support of regional and state-wide initiatives. Marinette County staff serves on several WLW committees.

Chapter 9. Monitoring and Evaluation

Little water quality monitoring, habitat inventory, or watershed wide gathering of agricultural data has occurred in the Lower Peshtigo River Watershed since 1990's. Fisheries data has been gathered on a limited basis. This plan will continue to be revised throughout the ten year implementation period as new data becomes available, as reflected in Figure 5-1.

Evaluation of program success has typically been a matter of counting; the dollars spent; the numbers and types of best management practices installed; the acres under conservation plans. Determining if best management practices are working, and if surface waters are becoming healthier, is a much more difficult task. The monitoring conducted for the creation of this plan could lay the ground work for measuring trends related to stream health and habitat quality in years to come. Unfortunately, funding and staff resources for regular monitoring within specific watersheds is not assured.

A number of new monitoring and evaluation tools and sources of information are becoming available. LiDAR may change the way agricultural BMP's are designed and constructed. It will facilitate use of new tools such as EVAAL to predict where cropland soil erosion is most likely to occur to help prioritize erosion control practices and limited staff and financial resources to ensure the practices are implemented and maintained. The Healthy Watershed Assessment tool (discussed in Chapter 2) will suggest new areas to look at and new ways to look at them. SNAP+ will help determine the effectiveness of cropland BMP's. Some of these tools and information still have not arrived yet. Others need additional training and time to put to use. See Figure 5-1 for planned monitoring activities and scheduling.

Macro-Invertebrate Monitoring

Aquatic Insects are good indicators of stream and surface water health. Insect samples were taken from a number of sites across the watershed in both 2014 and 2015. Due to a significant backlog in analysis, this data will not be available in time for inclusion in this plan. However, it will be part of future plan revisions.

Phosphorus Monitoring

In 2014 and again 2015, nine watershed sites were monitored for Phosphorus, a limiting nutrient for aquatic plant growth. The results of that monitoring are shown below in Figures 9-1 and 9-2. Any new data will be incorporated into future plan revisions. To understand this data refer to the Stream Monitoring Locations map (Figure 9-3) and the Lower Peshtigo River HUC 10 Land Cover Map. Individual Total Phosphorus monitoring reports can be viewed in Appendix 1. The Wisconsin Water Quality Standard is based on the median of six Total Phosphorus samples collected between May and October.

- Phosphorus levels were generally below the state standard of .075 milligrams per liter except for the Trout Creek HUC 12. This unit has the highest density of farms in the LPRW. The 2014 Phosphorus monitoring site was located near the bottom of the subwatershed. In 2015, all five monitoring sites in the Trout Creek HUC 12 exhibited TP levels above .075, including one event where total phosphorus was almost 6 times the state standard.

- The Gravelly Brook HUC12 is headwater area for the watershed and has relatively low levels of agricultural activity. As expected, these HUC's have the lowest phosphorus levels.

- A block of cropland is shown in the Land Cover Map just above the monitoring sites for the Unnamed Tributaries to Lake Michigan and below Spitzmacher Road in the southern tip of the Peshtigo River – Frontal Lake Michigan HUC 12, leading to the elevated phosphorus levels.

- Elevated phosphorus levels were noted at the Unnamed Tributary to the Peshtigo River at County Road RW in the Peshtigo Dam – Peshtigo River HUC12. The area drained by this unnamed tributary only contains one block of cropland. Additional investigation is warranted.

Figure 9-1 2014 Phosphorus Monitoring Results

Month	Little R. at BB	Mud Brook	Trout Creek @ Townline Rd	Unnamed Trib. Spitzmacher Rd.	Unnamed Trib @ RW Rd.	Unamed Trib. Lk Mich.	State P Standard
May	0.0457	0.0165		0.0590	0.0459	0.0684	**0.0750**
June	0.0534	0.0510	0.1080	0.0673	0.0820	0.0813	**0.0750**
July	0.0488	0.0451	0.0485	0.0383	0.0695	0.0290	**0.0750**
August	0.0435	0.0435	0.1340	0.0360	0.0605	0.0662	**0.0750**
September	0.0438	0.0299	0.0705	0.0626	0.0429	0.0659	**0.0750**
October	0.0326	0.0368	0.1360	0.0574	0.0575	0.0403	**0.0750**
Median	0.0448	0.0402	0.108	0.0582	0.059	0.06605	**0.0750**

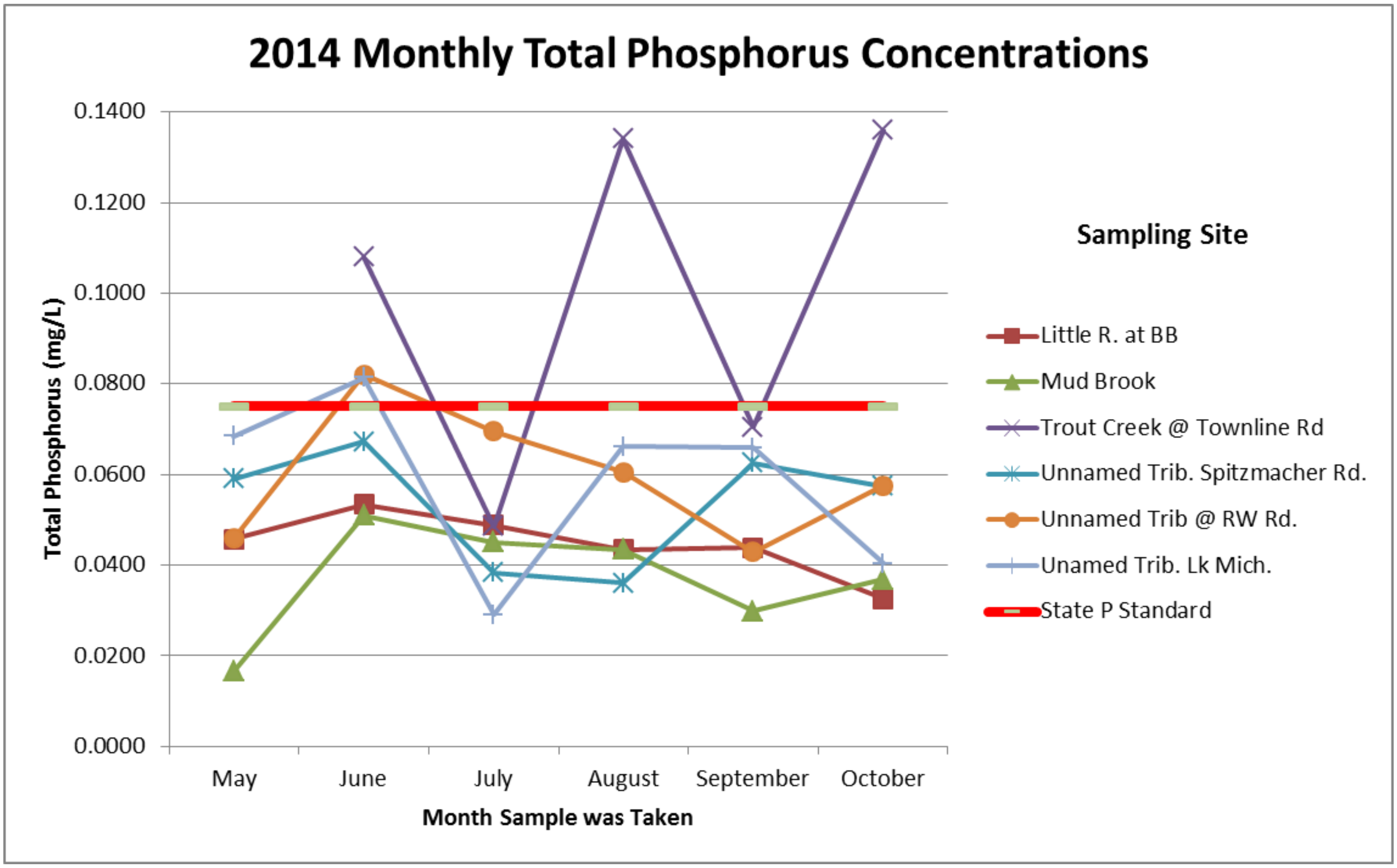


Figure 9-2. 2015 Phosphorus Monitoring Results

	Bundy Creek @ Town Hall Road	Little Peshtigo River @ Cty W	Sucker Creek @ Aubin St.	Trout Creek @ Poplar Ridge	Trout Creek @ Jandt Road	UNT to Peshtigo R. @ River Road	UNT Peshtigo R. @ CTH B	UNT Peshtigo R. @ CTH BB	UNT Trout Creek 130 m DS Aubin	State P Standard
May	0.0629	0.04	0.0388	0.0611	0.0794	0.0162	0.031	0.0185	0.0559	**0.0750**
June	0.13	0.0924	0.0613	0.119	0.129	0.0581	0.0352	0.0418	0.0796	**0.0750**
July	0.0328	0.0464	0.0344	0.0522	0.0458	0.0371	0.0307	0.0328	0.212	**0.0750**
August	0.0609	0.0839	0.0926	0.127	0.448	0.0733	0.0245	0.0398	0.238	**0.0750**
September	0.0561	0.069	0.0207	0.041	0.0297	0.0231	0.0362	0.0232	0.0722	**0.0750**
October	0.0345	0.0405	0.0288	0.0303	0.0225	0.0224	0.0184	0.0165	0.036	**0.0750**
Median	0.0585	0.0577	0.0366	0.05665	0.0626	0.0301	0.03085	0.028	0.0759	**0.0750**

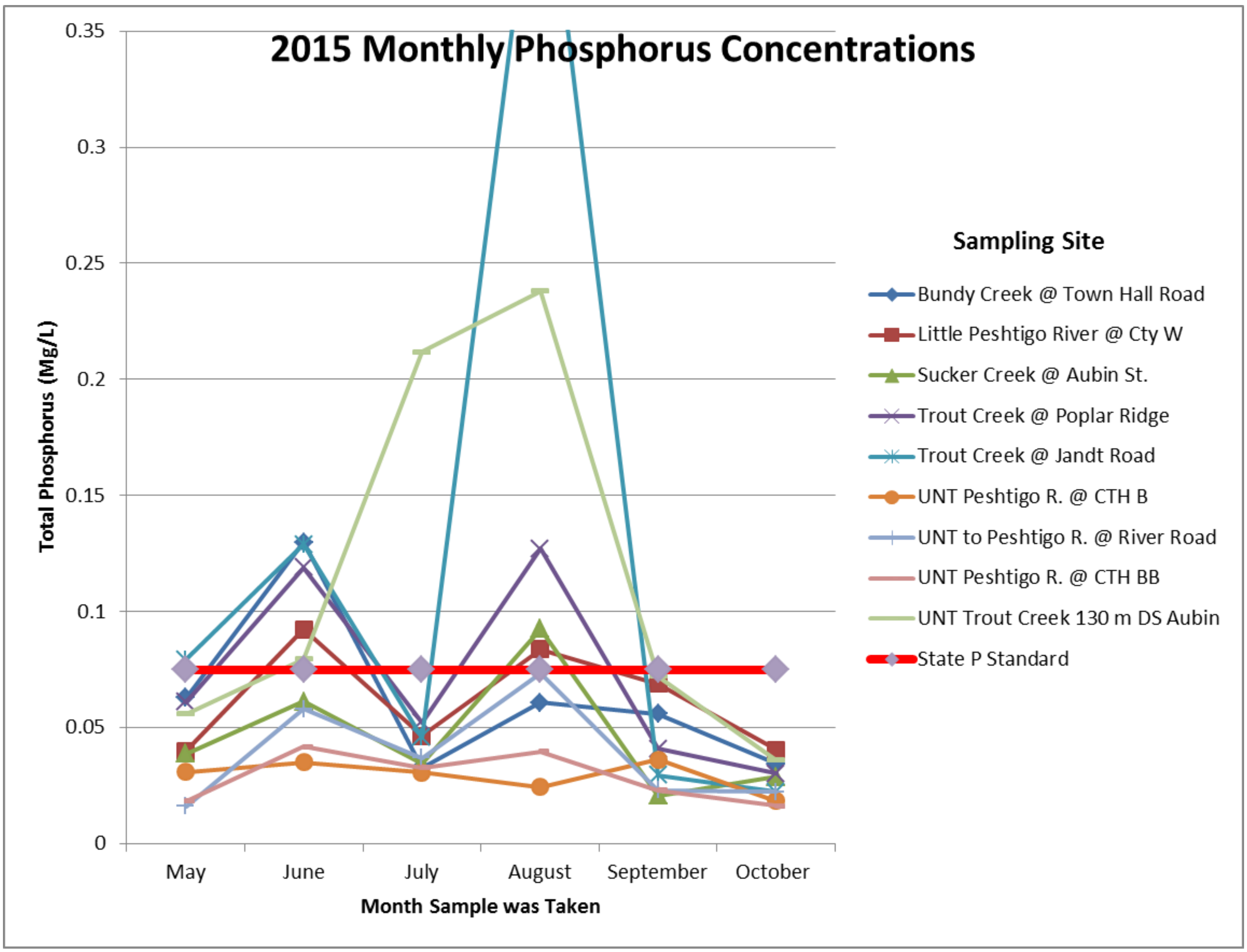
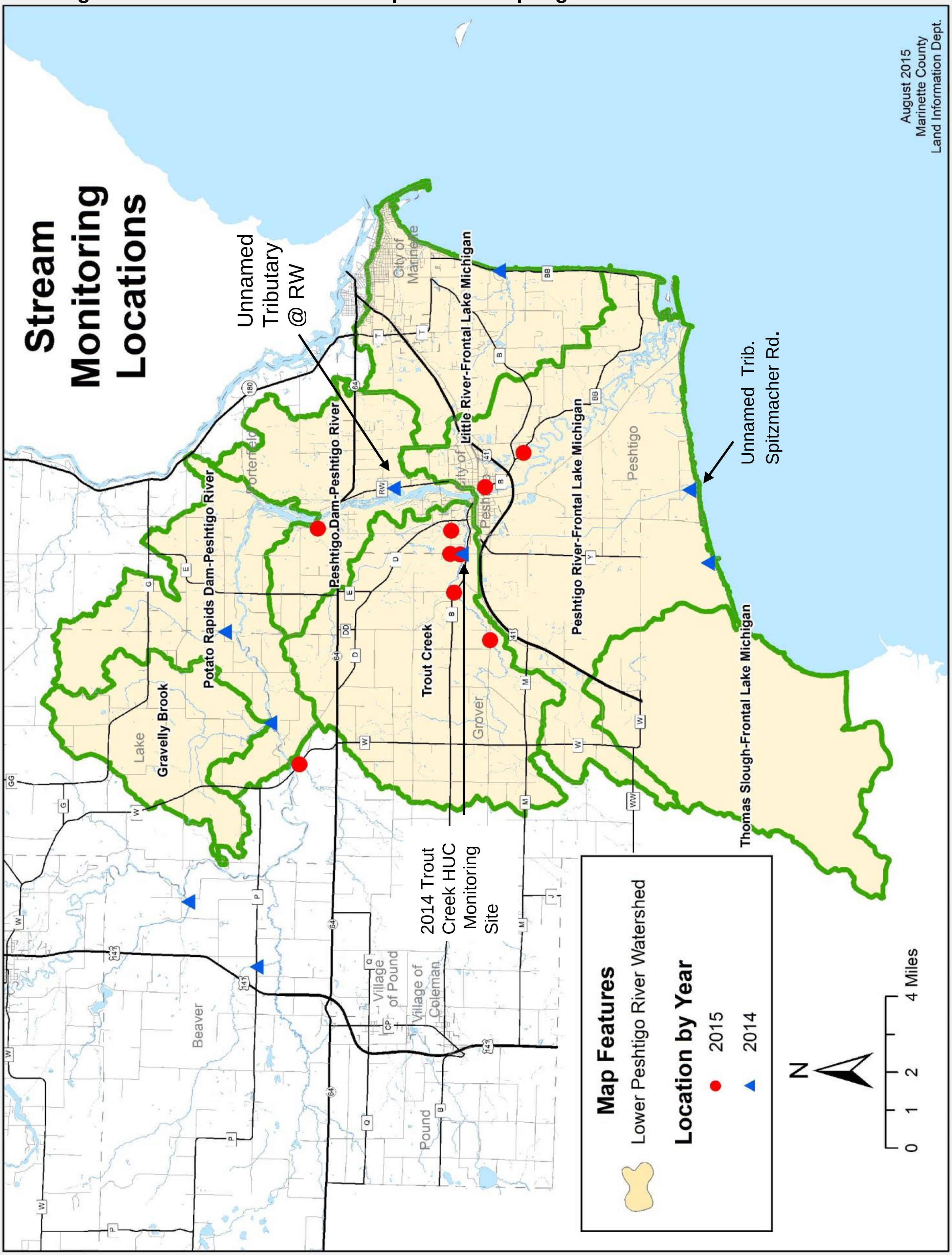


Figure 9-3. 2014 and 2015 Phosphorus Sampling Locations



Fish Indices of Biological Integrity and Habitat Ratings

Fish Indices of Biological Integrity (F-IBIs) have been developed by WDNR research staff and are used to assess the biological health and quality of fish assemblages of streams and rivers. F-IBIs have been customized to account for differences in stream morphology, water temperature and fish species associated with rivers and streams. A fish IBI has not been developed for any of the small streams lacking sufficient perennial flow to support a fish community. The indices use a large statewide database of standardized fish assemblage surveys from numerous reaches with different levels of human impact. An objective procedure was used to select and score the metrics that compose the various F-IBIs, choosing metrics that represent a variety of the structural, compositional, and functional attributes of fish assemblages. The attributes include the types of fish, native vs non-native species, pollution tolerance, salmonids, etc.

As might be expected, the presence and intensity of agricultural activity in a HUC 12 sub watershed corresponds with poorer IBI and Habitat Rating scores. It is important to understand that the IBI represents a length of the stream while the Habitat Rating represents almost a point. Tables (Figure 9-4) provide the numeric basis for scores from Poor to Excellent and the individual metrics that make up the indices for each stream type/size. The actual scores, by monitoring site and HUC 12 are shown in Figure 9-3.

- The Trout Creek HUC 12 was monitored for both IBI and Habitat Rating at 11 sites because this unit has most intense agricultural use and phosphorus levels. For the IBI's, 4 sites rated poor, 6 fair and 1 good. The Habitat Ratings were 6 fair and 5 good.

- The Gravelly Brook unit was monitored at one site. The IBI was Excellent but the Habitat Rating was only Good.

- The Peshtigo River – Frontal Lake Michigan HUC 12, really represents two worlds. The main river flows through largely undeveloped forest and wetland. Its scores reflect that. The tributaries have been heavily impacted, in some cases ditched, by cultural activities and the scores reflect that. The IBI's for the two Peshtigo River sites were Excellent, while at the four tributaries Poor. Habitat for the Tributaries was Fair or Good.

Figure 9-4. Index for Biological Integrity (IBI) and Habitat Ratings Scores

HUC 12	Stream Name	Stream Crossing Point	Natural Community Type	Fish IBI	Score	Habitat Rating	Score
Gravelly Brook	Gravelly Brook	Confluence w/Peshtigo	CWHW	Excellent	80	Good	68
Little River - Frontal Lk Michigan	Little River	Krause Rd	CWHW	Excellent	75	Good	50
	Little River	Hwy BB	CWMS	Good	65	Fair	57
Peshtigo Dam - Peshtigo River	UN Trib to Pesh	RW Road	CWHW	Good	60	Fair	25
	UNT to Peshtigo River	Hwy 64	CWHW	Poor	30	Good	55
	UNT to Peshtigo River	River Dr	CWHW	Poor	30	Good	53
	UNT to Peshtigo River	Access Rd to Potato Rapids Dam	CCHW	Poor	10	Good	65
Peshtigo River - Frontal Lk Michigan	Peshtigo River	Mouth	Large River	Excellent	85	NA	NA
	UNT TO LM in Oconto Park	CTH Y	CCHW	Excellent	100	Good	50
	UNT to LM Spitzmacher Rd	DS Spitzmacher Rd	Coldwater	Poor	25	Fair	40
	UNT to Lake Michigan (Bay)	Hwy BB	CHWH	Poor	15	Fair	30
	UNT to Peshtigo River	Hwy BB	CCHW	Poor	20	Good	50
	UNT to Peshtigo River	Hwy B	CCHW	Poor	0	Good	60
Potato Rapids Dam - Peshtigo River	Mud Brook	Mud Brook Road	CWHW	Good	60	Fair	40
	Gravelly Brook	Gravelly Brook Rd	CWHW	Excellent	70	Fair	43
	Mud Brook	Hwy G	CWHW	Poor	20	Good	50
Trout Creek	Bundy Creek	Townline Road- East	WHW	Fair	40	Fair	70
	Bundy Creek	CTH B	WHW	Fair	40	Good	70
	Trout Creek	Hwy B-townline Road	WHW	Fair	50	Good	68
	Bundy Creek	CTH B	WHW	Poor	10	Good	50
	Trout Ctreek	CTH D	CWHW	Good	60	Good	63
	Bundy Creek	Townline Rd	WHW	Fair	50	Fair	43
	Bundy Creek	Townline Rd	WHW	Fair	50	Fair	45
	UNT to Trout Creek (Sucker Brook)	Aubin St	CWHW	Poor	15	Good	58
	UNT to Trout Creek	Aubin St	CWHW	Fair	45	Fair	30
	Sucker Brook	Farm Rd Access off Hwy E	CWHW	Poor	15	Fair	35
	Trout Creek	Jandt Road	CWHW	Poor	20	Fair	25

Figure 9-5 **Condition category thresholds for applicable fish indices of biotic integrity (IBI).**

Natural Community	Fish IBI Type	Fish IBI	Condition Category
Coldwater	Coldwater Fish	81-100	Excellent
		51-80	Good
		21-50	Fair
		0-20	Poor
Cool-Cold or Cool-Warm Headwater	Small-Stream (Intermittent) Fish	91-100	Excellent
		61-90	Good
		31-60	Fair
		0-30	Poor
Cool-Cold Mainstem	Cool-Cold Transition Fish	61-100	Excellent
		41-60	Good
		21-40	Fair
		0-20	Poor
Cool-Warm Mainstem	Cool-Warm Transition Fish	61-100	Excellent
		41-60	Good
		21-40	Fair
		0-20	Poor
Warm Headwater	Small-Stream (Intermittent) Fish	91-100	Excellent
		61-90	Good
		31-60	Fair
		0-30	Poor
Warm Mainstem	Warmwater Fish	66-100	Excellent
		51-65	Good
		31-50	Fair
		0-30	Poor
Large River	River Fish	81-100	Excellent
		61-80	Good
		41-60	Fair
		0-40	Poor

Cold F-IBI	Warm - IBI	Small F-IBI	Large R. F-IBI	Cool-Warm F-IBI	Cool-Cold F-IBI
a) # intolerant species b) % tolerant species c) % top carnivore species d) % native or exotic stenothermal coldwater or coolwater species e) % salmonids that are brook trout	a) # native species b) # darter species c) # sucker species d) # sunfish species e) # intolerant species f) % tolerant species g) Percent omnivores h) % insectivores i) % top carnivores j) % simple Hthophils k) # of individuals per 300m2 l) % diseased fish	a) # native species b) # intolerant species c) # minnow species d) # headwater species e) Total catch per 100m, excluding Tolerant species f) Catch per 100 m of brook stickleback g) % diseased fish	a) Weight Biomass PUE b) # native species c) # sucker species d) # intolerant species e) # riverine species f) % diseased fish g) % riverine h) % lithophils i) % insectivore j) % round suckers	a) # native minnow species b) # intolerant species c) % tolerants d) # benthic invertivore species e) % omnivores	a) # darter, madtom and sculpin species b) # coolwater species c) # intolerant species d) % tolerant species e) % generalist feeders
The Individual Metrics above determine the IBI scores					

Natural Communities

The Natural Communities shown in the table above are defined as:

Coldwater – small to large perennial streams with cold summer water temperatures. Coldwater fish range from common to dominant (25-100% of individuals), transitional fish from absent to abundant (up to 75% of individuals), and warmwater fish from absent to rare (0-5% of individuals). Small-stream, medium-stream, and large-river fish range from absent to dominant (0-100% of individuals).

Cool-Cold Headwater (CCHW) – small, usually perennial streams with cool to cold summer water temperatures. Coldwater fish range from absent to abundant, transitional fish from common to dominant, and warmwater fish from absent to common. Small-stream fish range from very common to dominant (50-100% of individuals), medium-stream fish from absent to very common (0-50% of individuals), and large-river fish from absent to uncommon (0-10% of individuals).

Cool-Warm Headwater (CWHW) – small, sometimes intermittent streams with cool to warm summer temperatures. Coldwater fish range from absent to common, transitional fish from common to dominant, and warmwater fish from absent to abundant. Small-stream fish range from very common to dominant, medium-stream fish from absent to very common, and large-river fish from absent to uncommon.

Cool-Warm Mainstem (CWMS) – moderate to large but still wadeable perennial streams with cool to warm summer temperatures. Coldwater fish range from absent to common, transitional fish from common to dominant, and warmwater fish from absent to abundant. Smallstream fish range from absent to very common, medium-stream fish from very common to dominant, and large-river fish from absent to very common.

Warm headwater (WHW) – small, usually intermittent streams with warm summer temperatures. Coldwater fish range from absent to rare, transitional fish from absent to common, and warmwater fish from abundant to dominant. Small-stream fish range from very common to dominant, medium-stream fish from absent to very common, and large-river fish from absent to uncommon.

Large rivers – non-wadeable large to very-large rivers. Summer water temperatures are almost always cool-warm or warm, although reaches are identified based strictly on flow. Coldwater fish range from absent to rare, transitional fish from absent to common, and warmwater fish from abundant to dominant. Small-stream fish range from absent to uncommon, medium-stream fish from absent to common, and large-river fish from abundant to dominant.

Crop Land Soil Phosphorus Monitoring and Evaluation

Nutrient Management Plan data from twelve farms was obtained. Phosphorus levels for 354 fields covering 3953.5 acres were mapped. One of the implementation goals for this plan is to obtain soil phosphorus data for all the nutrient management plans in the watershed. Then changes in soil phosphorus levels will be tracked as new soil sample data is received from updated nutrient management plans. Marinette County will make use of **SnapPlus** to ensure nutrient management plans are prepared and implemented in accordance with Wisconsin's Nutrient Management Standard Code 590 and help comply with applicable NR 151 performance standards for tillage setback, P-Index, process wastewater and soil loss form sheet, rill, and wind erosion.

Implementation Evaluation

Progress and implementation of the Lower Peshtigo River Watershed Project will be tracked by the following components:

1) Information and education activities and participation

2) Pollution reduction evaluation based on BMP's installed using STEPL and SNAP+ models

3) Water quality monitoring

4) Administrative review

The Marinette County Land Information Department, especially the Land and Water Conservation Division will be responsible for tracking progress of the plan (See figures 5-1, 5-4, and 6-2 for plan milestones). NRCS staff will also be asked to assist with tracking progress and implementation of practices. Information will be assembled and analyzed annually and stored in the Marinette County GIS and/or departmental files. Reports will be completed when needed and appropriate, especially if significant revisions are needed in the implementation plan.

Marinette County will make a good faith effort to follow through on all of the items listed below and to meet milestones shown in figures, 5-1, 5-4, and 6-2. However, full use of time intensive tools such STEPL, EVAAL, SNAP Plus, or costly items such as significant water sample analyses will likely require more staff and other resources than Marinette County can currently provide. In the absence of new external sources, Marinette County will annually complete the steps outlined below over this plan's ten year schedule, as existing county resources, state administrative codes, and other agency or landowner participation allow.

1) Information and education tracking (See Figure 5-5) will include:

a) Number of landowners/operators in the watershed plan area.

b) Number of eligible landowners/operators in the watershed plan area.

c) Number and type of landowner/operator contacts.

d) Number of cost-share agreements signed and/or projects instituted.

e) Number and Type of Information and education activities held, who lead the activity, how many invited, how many attended, and any measurable results of I& E activities.

f) Number of informational flyers/brochures distributed per given time period.

g) Number and type of project/watershed related articles placed in the *Northwoods Journal*.

h) Comments or suggestions for future activities.

i) Website or Facebook page visits

2) Installed best management practices will be mapped using GIS. Pollution reductions from completed projects will be evaluated using models and spreadsheet tools. Tracking will include:

a) Planned and completed BMP's.

b) Pollutant load reductions and percent of goal planned and achieved using STEPL or SNAP+ models.

Note: In the absence of Total Maximum Daily Load for any watershed stream or surface water in the Lower Peshtigo Watershed, load reductions may have to be developed by consensus between partner agencies or using best professional judgement

c) Cost-share funding source of planned and installed BMP's.

d) Numbers of checks to make sure management plans (nutrient management, grazing management) are being followed by landowners.

e) Number of checks to ensure practices are operated and maintained properly.

f) Number of new and alternative technologies and management measures used and incorporated into plan.

g) Mapping nutrient management plan implementation and updating field level soil phosphorus concentrations.

3) Water Quality and other Monitoring Reporting Parameters (See Figure 5-1):

a) Aquatic invasive species monitoring and mapping.

b) Repeating total phosphorus sampling as often as available resources allow.

c) Repeating macroinvertebrate Index of Biotic Integrity (IBI) and/or Fish- IBI as often as available resources allow.

d) Work with WDNR to incorporate the results of other fisheries monitoring into the plan.

e) If resources become available perform a fish passage inventory of the watershed stream crossings.

f) Investigate the lower scoring catchments identified in the Healthy Watershed Assessment.

g) Number of well samples mapped and analyzed

4) Administrative Review tracking and reporting will include:

a) Status of grants relating to project.

b) Status of project administration including data management, staff training and BMP monitoring.

c) Status of nutrient management planning, and easement acquisition and development.

d) Number of grants applied for

e) Number of cost-share agreements.

f) Total amount of money on cost-share agreements.

g) Total amount of landowner reimbursements made.

h) Staff salary and fringe benefits expenditures.

i) Staff travel expenditures.

j) Information and education expenditures.

k) Equipment, materials, and supply expenses.

k) Professional services and staff support costs.

l) Total expenditures for the county.

m) Total amount paid for installation of BMP's and amount encumbered for cost-share agreements.

Information and Education Indicators of Success:
0-2 years

a) Notice in local newspaper on completion of watershed plan.

b) Facebook/Website/or Page on county website developed for watershed information and updates.

c) 1 display at local library, government office, and/or local event

d) Distribution of informational materials on watershed project and conservation practices to eligible land owners, including the owners of formerly commercial operations.

f) At least 15 one on one contacts made with agricultural landowners.

g) At least 2 meetings held with agricultural landowners.

h) At least 1 educational workshops held.

i) Annual inclusion of watershed related articles in the Northwoods Journal

2-5 years
Further educational efforts are fully dependent on the status and degree of completion of other implementation goals

For consistency with EPA's element 8, if less than 20% of the planned management and structural practices, WQ assessment actions or financial costs shown in this plan are not achieved or made available via grants or other funding sources by year 5 of this plan, revision of the plan's P and sediment reduction objectives and milestones shall be completed to reflect the minimal progress.

For consistency with EPA's Elements 2, 8, and 9 and accounting for diminishing returns/pollutant reductions from structural and non-structural practices over time, the following EPA technical memorandum on BMP depreciation will be reviewed and used as guidance to evaluate plan implementation;
http://www.epa.gov/sites/production/files/2015-10/documents/tech_memo_10ct15.pdf.
See appendix 3.

Appendices

Appendix 1. 2014 and 2015 Water Action Volunteer Total Phosphorus Monitoring Program Results for the Lower Peshtigo River Watershed

Why Phosphorus?

Phosphorus is an essential nutrient responsible for plant growth, but it is also the most visible, widespread water pollutant in Wisconsin lakes. Small increases in phosphorus levels in a lake can bring about substantial increases in aquatic plant and algae growth, which in turn can reduce the recreational use and aquatic biodiversity of said lake. When the excess plants die and are decomposed, oxygen levels in the water drop dramatically which can lead to fish kills.

Additionally, one of the most common impairments in Wisconsin's streams is excess sediments that cover stream bottoms. Since phosphorus moves attached to sediments, it is intimately connected with this source of pollution in our streams. Phosphorus originates naturally from rocks, but its major sources in streams and lakes today are usually associated with human activities: soil erosion, human and animal wastes, septic systems, and runoff from farmland or lawns. Phosphorus-containing contaminants from urban streets and parking lots such as food waste, detergents, and paper products are also potential sources of phosphorus pollution from the surrounding landscape. The impact that phosphorus can have in streams is less apparent than in lakes due to the overall movement of water, but in areas with slow velocity, where sediment can settle and deposit along the bottom substrate, algae blooms can result.



Photo credits to Matt Berg, David Seligman, Linda Warren, and Adrian Konell

Volunteer Monitoring Protocol

To assess in stream phosphorus levels, WAV volunteers collected water samples that were analyzed for total phosphorus (TP) at the State Lab of Hygiene during the growing season (May through October). Following Wisconsin Department of Natural Resources (WDNR) methods, six phosphorus water samples were collected at each monitoring site - one per month for each of the six months during the growing season, The water samples were collected approximately 30 days apart and no samples were collected within 15 days of one another.
Total phosphorus impairment is assessed using the criteria in the table below.

TP Criteria Exceeded

The total phosphorus criteria is exceeded if the lower confidence limit of the sample median exceeds the state total phosphorus criteria of 0.075 mg/L.

Watch Waters

The site is classified as Watch Waters if the median total phosphorus concentration falls within the confidence limit.

TP Criteria Met

The total phosphorus criteria is met if the upper limit of the confidence interval does not exceed the state total phosphorus criteria of 0.075 mg/L.

PROJECT PARTNERS

WISCONSIN DEPT. OF NATURAL RESOURCES

Water Action Volunteers

UW Extension
University of Wisconsin-Extension

Marinette County — Waterfalls Capital of Wisconsin

Monitoring Site Information

SWIMS Station ID	10039303
County	Marinette
Watershed	Lower Peshtigo River
Watershed Area	194.98 sq miles
Total Stream Miles in Watershed	281.45 miles
Downstream Waterbody	Lake Michigan
Volunteer(s)	Greg Cleereman

2014 Monitoring Results

Min TP Value	0.0326 mg/L
Max TP Value	0.0534 mg/L
Median TP Value	0.04475 mg/L
No. Samples > 0.075 mg/L	0

Map Legend ★ - Sampling Location for 2014

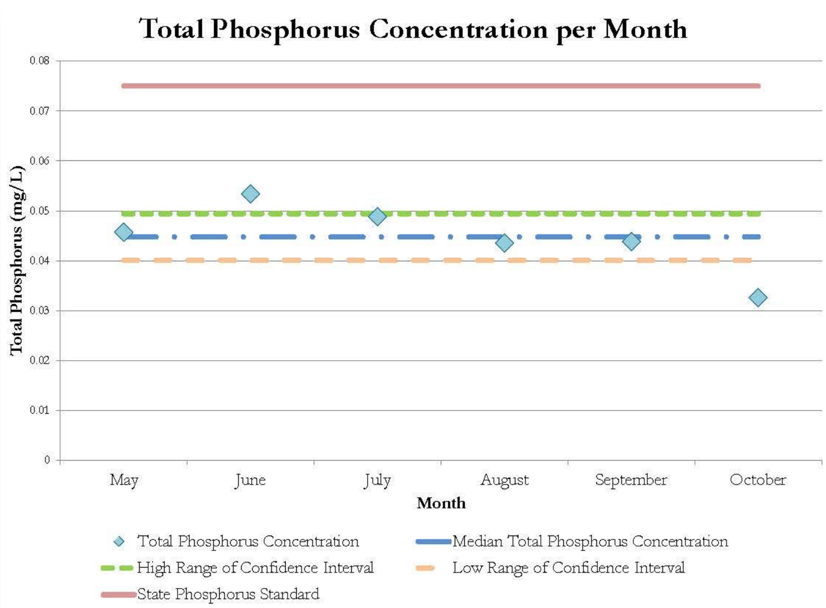
TP Criteria Met

Volunteer Total Phosphorus Monitoring

Little River at Hwy BB

2014 Monitoring Results

This project will monitor and evaluate streams in the Lower Peshtigo River Watershed in Marinette and Oconto Counties. Just under 50% of the streams and rivers in this watershed have unknown fish and aquatic life condition. Basin assessment monitoring was recommended in historic watershed plans, but have never been conducted. The monitoring will help support and guide the development of the 9-Key Element plan by gathering baseline data and eliminating data gaps.

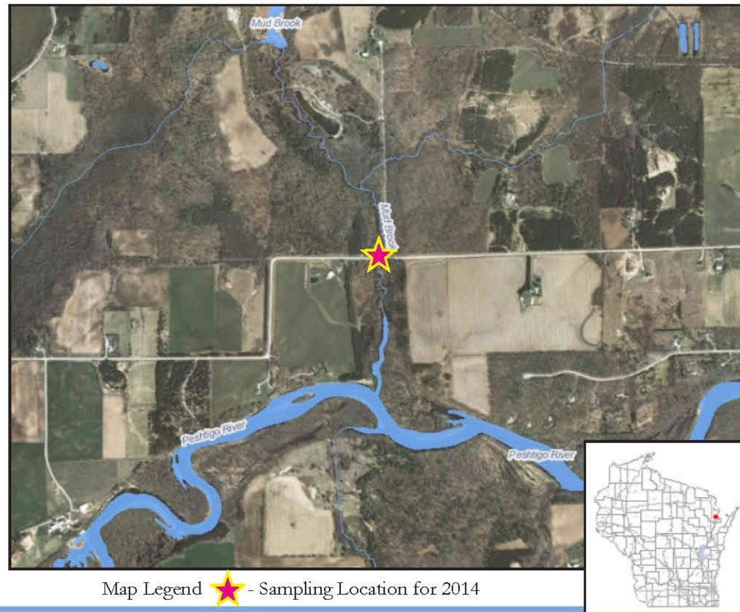


Monitoring Site Information

SWIMS Station ID	383175
County	Marinette
Watershed	Lower Peshtigo River
Watershed Area	194.98 sq miles
Total Stream Miles in Watershed	281.45 miles
Downstream Waterbody	Peshtigo River
Volunteer(s)	Greg Cleereman

2014 Monitoring Results

Min TP Value	0.0165 mg/L
Max TP Value	0.051 mg/L
Median TP Value	0.04015 mg/L
No. Samples > 0.075 mg/L	0



Map Legend ★ - Sampling Location for 2014

TP Criteria Met

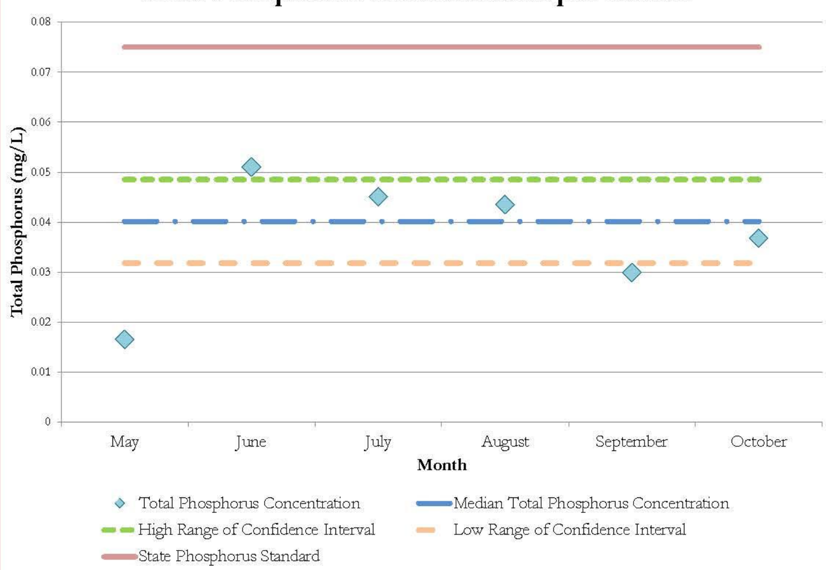
Volunteer Total Phosphorus Monitoring

Mud Brook at Mudbrook Road

2014 Monitoring Results

This project will monitor and evaluate streams in the Lower Peshtigo River Watershed in Marinette and Oconto Counties. Just under 50% of the streams and rivers in this watershed have unknown fish and aquatic life condition. Basin assessment monitoring was recommended in historic watershed plans, but have never been conducted. The monitoring will help support and guide the development of the 9-Key Element plan by gathering baseline data and eliminating data gaps.

Total Phosphorus Concentration per Month



Monitoring Site Information

SWIMS Station ID	10041618
County	Marinette
Watershed	Lower Peshtigo River
Watershed Area	194.98 sq miles
Total Stream Miles in Watershed	281.45 miles
Downstream Waterbody	Peshtigo River
Volunteer(s)	Greg Cleereman

2014 Monitoring Results

Min TP Value	0.0485 mg/L
Max TP Value	0.136 mg/L
Median TP Value	0.108 mg/L
No. Samples > 0.075 mg/L	3

Map Legend ★ - Sampling Location for 2014

TP Criteria Exceeded

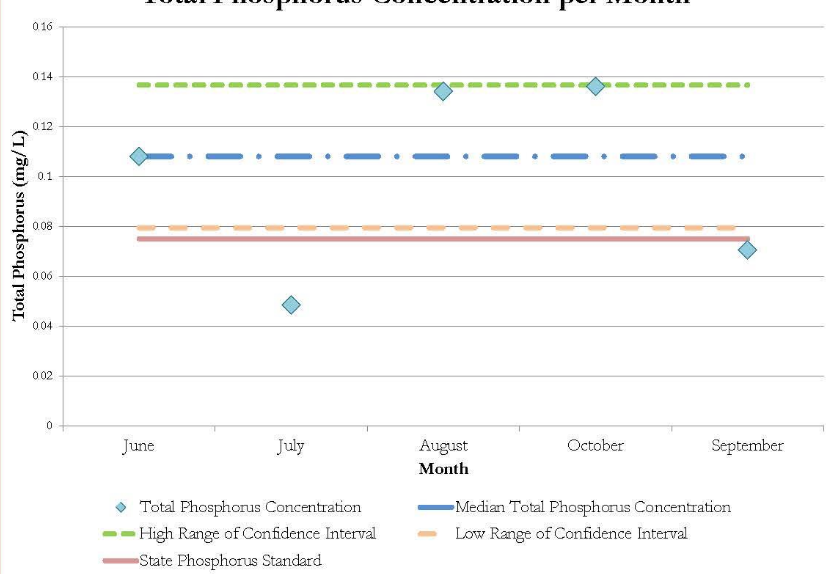
Volunteer Total Phosphorus Monitoring

Trout Creek at Townline Road

2014 Monitoring Results

This project will monitor and evaluate streams in the Lower Peshtigo River Watershed in Marinette and Oconto Counties. Just under 50% of the streams and rivers in this watershed have unknown fish and aquatic life condition and basin assessment monitoring was recommended in historic watershed plan recommendations, but has never been conducted. The monitoring will help support and guide the development of the 9-Key Element plan by gathering baseline data and eliminating data gaps.

Total Phosphorus Concentration per Month



Monitoring Site Information

SWIMS Station ID	10041617
County	Marinette
Watershed	Lower Peshtigo River
Watershed Area	194.98 sq miles
Total Stream Miles in Watershed	281.45 miles
Downstream Waterbody	Lake Michigan
Volunteer(s)	Greg Cleereman

2014 Monitoring Results

Min TP Value	0.036 mg/L
Max TP Value	0.0673 mg/L
Median TP Value	0.0582 mg/L
No. Samples > 0.075 mg/L	0

Map Legend ★ - Sampling Location for 2014

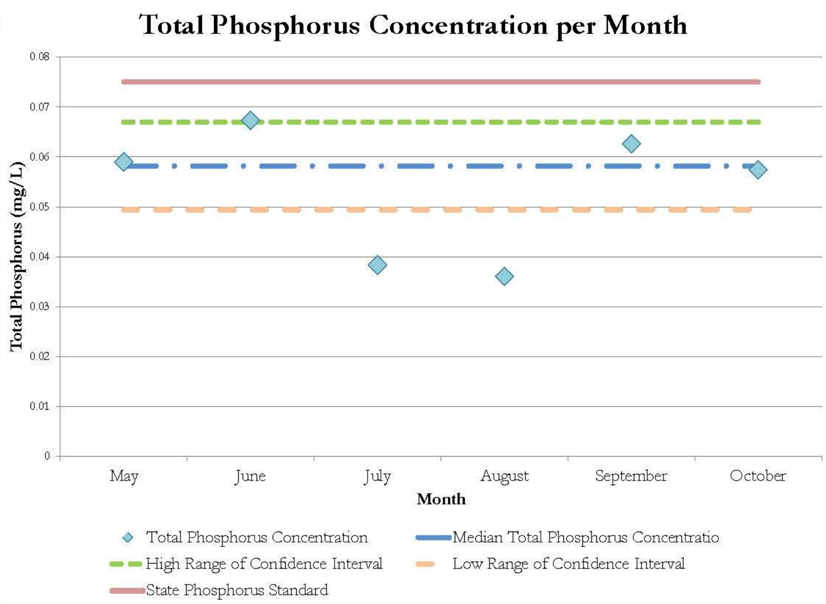
TP Criteria Met

Volunteer Total Phosphorus Monitoring

UN Trib to Lake Michigan 400m DS Spitzmacher Road

2014 Monitoring Results

This project will monitor and evaluate streams in the Lower Peshtigo River Watershed in Marinette and Oconto Counties. Just under 50% of the streams and rivers in this watershed have unknown fish and aquatic life condition. Basin assessment monitoring was recommended in historic watershed plans, but have never been conducted. The monitoring will help support and guide the development of the 9-Key Element plan by gathering baseline data and eliminating data gaps.

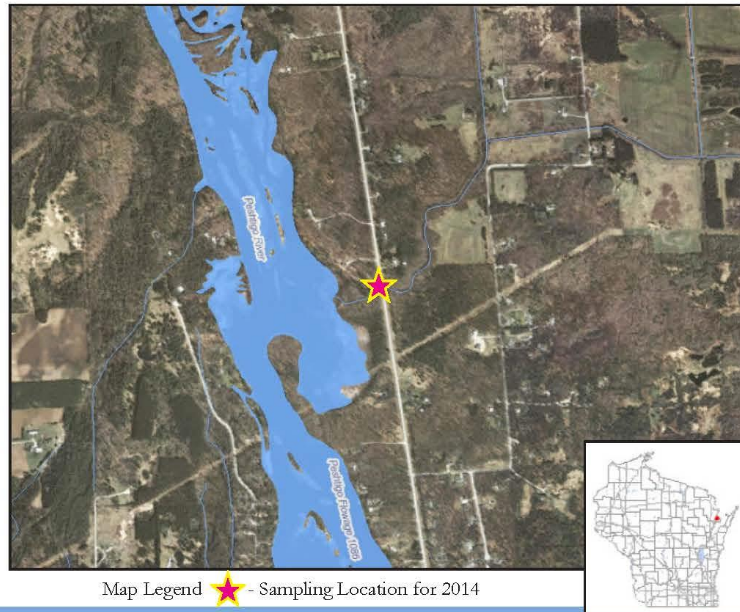


Monitoring Site Information

SWIMS Station ID	10041619
County	Marinette
Watershed	Lower Peshtigo River
Watershed Area	194.98 sq miles
Total Stream Miles in Watershed	281.45 miles
Downstream Waterbody	Peshtigo River
Volunteer(s)	Greg Cleereman

2014 Monitoring Results

Min TP Value	0.0429 mg/L
Max TP Value	0.082 mg/L
Median TP Value	0.059 mg/L
No. Samples > 0.075 mg/L	1



Map Legend ★ - Sampling Location for 2014

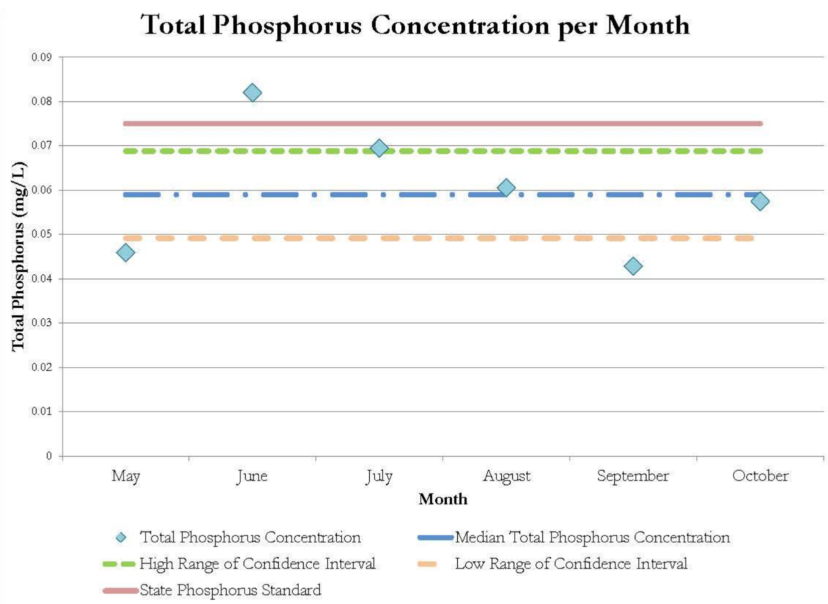
TP Criteria Met

Volunteer Total Phosphorus Monitoring

UN Trib to Peshtigo River US Right of Way Rd

2014 Monitoring Results

This project will monitor and evaluate streams in the Lower Peshtigo River Watershed in Marinette and Oconto Counties. Just under 50% of the streams and rivers in this watershed have unknown fish and aquatic life condition. Basin assessment monitoring was recommended in historic watershed plans, but have never been conducted. The monitoring will help support and guide the development of the 9-Key Element plan by gathering baseline data and eliminating data gaps.



Monitoring Site Information

SWIMS Station ID	10033582
County	Oconto
Watershed	Little River
Watershed Area	210.34 sq miles
Total Stream Miles in Watershed	318.76 miles
Downstream Waterbody	Lake Michigan
Volunteer(s)	Greg Cleereman

2014 Monitoring Results

Min TP Value	0.029 mg/L
Max TP Value	0.0813 mg/L
Median TP Value	0.06605 mg/L
No. Samples > 0.075 mg/L	1

Map Legend ★ - Sampling Location for 2014

Watch Waters

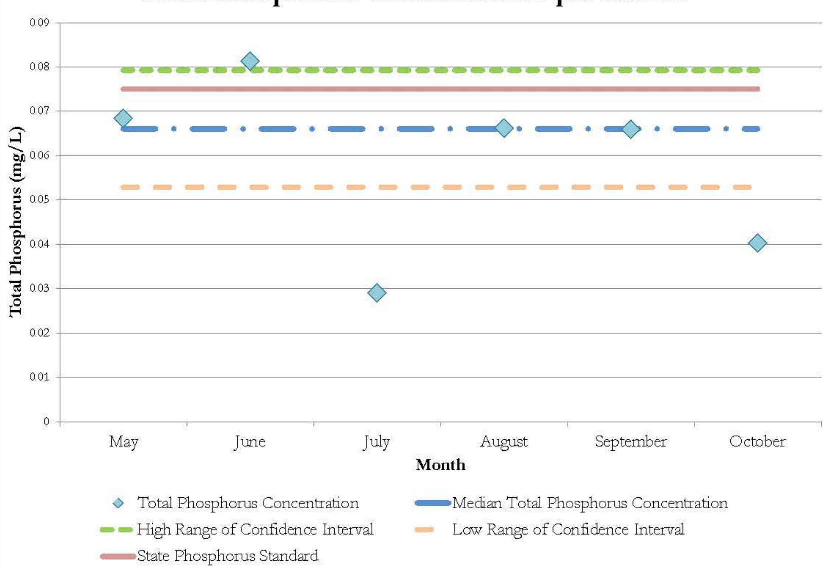
Volunteer Total Phosphorus Monitoring

Un. Trib to Lake Michigan in Oconto Park

2014 Monitoring Results

This project will monitor and evaluate streams in the Lower Peshtigo River Watershed in Marinette and Oconto Counties. Just under 50% of the streams and rivers in this watershed have unknown fish and aquatic life condition and basin assessment monitoring was recommended in historic watershed plan recommendations, but has never been conducted. The monitoring will help support and guide the development of the 9-Key Element plan by gathering baseline data and eliminating data gaps.

Total Phosphorus Concentration per Month



Why Phosphorus?

Phosphorus is an essential nutrient responsible for plant growth, but it is also the most visible, widespread water pollutant in Wisconsin lakes. Small increases in phosphorus levels can bring about substantial increases in aquatic plant and algae growth, which in turn can reduce the recreational use and aquatic biodiversity When the excess plants die and are decomposed, oxygen levels in the water drop dramatically which can lead to fish kills.

Additionally, one of the most common impairments in Wisconsin's streams is excess sediments that cover stream bottoms. Since phosphorus moves attached to sediments, it is intimately connected with this source of pollution in our streams. Phosphorus originates naturally from rocks, but its major sources in streams and lakes today are usually associated with human activities: soil erosion, human and animal wastes, septic systems, and runoff from farmland or lawns. Phosphorus-containing contaminants from urban streets and parking lots such as food waste, detergents, and paper products are also potential sources of phosphorus pollution from the surrounding landscape. The impact that phosphorus can have in streams is less apparent than in lakes due to the overall movement of water, but in areas with slow velocity, where sediment can settle and deposit along the bottom substrate, algae blooms can result.

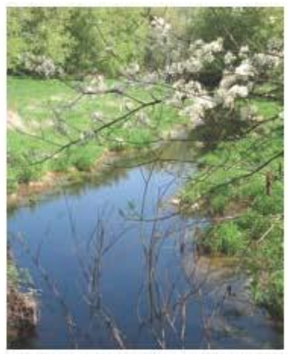




Photo credits to Matt Berg, David Seligman, Linda Warren, Adrian Konell, and Lindsey Albright (front)

Volunteer Monitoring Protocol

To assess in stream phosphorus levels, WAV volunteers collected water samples that were analyzed for total phosphorus (TP) at the State Lab of Hygiene during the growing season (May through October). Following Wisconsin Department of Natural Resources (WDNR) methods, six phosphorus water samples were collected at each monitoring site - one per month for each of the six months during the growing season, The water samples were collected approximately 30 days apart and no samples were collected within 15 days of one another.

A stream site is considered "impaired" if: 1) the lower 90% confidence limit of the sample median exceeds the state TP criterion of 0.075 mg/L or 0.1 mg/L or 2) there is corroborating WDNR biological data to support an adverse response in the fish or macroinvertebrate communities. If there is insufficient data for either of these requirements, more data will need to be collected in subsequent years before an impairment decision can be made. A site is designated as a "watch water" if the median total phosphorus concentration falls within the confidence limit and a site is considered to have "met criteria" is the upper limit of the confidence interval does not exceed the criterion.

TP Criteria Exceeded

Watch Waters

TP Criteria Met

PROJECT PARTNERS

Wisconsin Dept. of Natural Resources · Water Action Volunteers · Environmental Resources Center · UW Extension, University of Wisconsin-Extension

Water Action Volunteers
2015 Total Phosphorus Monitoring Program
Bundy Creek US Town Hall Road E of Hartwig Road

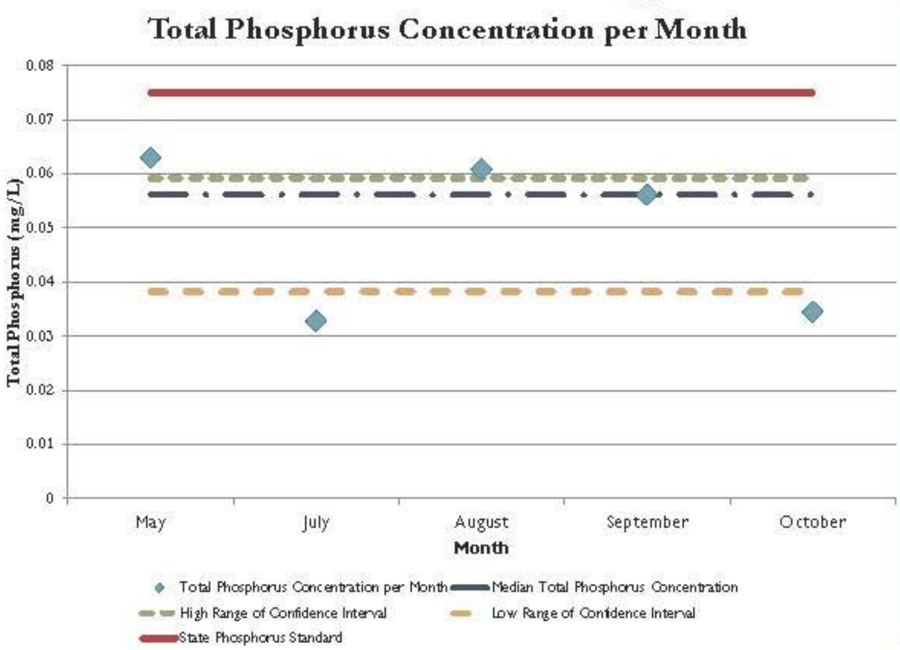
TP Criteria Met

Greg Cleereman

Monitoring Site Quick Facts	
SWIMS Station ID	10042548
WBIC	516100
County	Marinette
Watershed	Lower Peshtigo River
Watershed Area	194.98 sq miles
Total Stream Miles	281.45
Downstream Waterbody	Trout Creek

2015 Monitoring Results	
Minimum TP Value	0.0328 mg/L
Maximum TP Value	0.0629 mg/L
Median TP Value	0.0561 mg/L
No. Samples > 0.075mg/L	0

Map Legend ★ - Sampling Location for 2015



As part of this project, Water Action Volunteers stream monitors collected water samples in streams in the Lower Peshtigo River watershed in Marinette and Oconto Counties. Basin assessment monitoring was recommended in historic watershed plan recommendations, but has never been conducted. Marinette County is seeking to develop a 9-Key Element plan for a HUC-12 sub-watershed or the entire Lower Peshtigo River watershed. This monitoring will help support and guide the development of the 9-Key Element plan by gathering baseline data and eliminating data gaps.

Water Action Volunteers

2015 Total Phosphorus Monitoring Program

Sucker Creek at Aubin St. E of Poplar Ridge

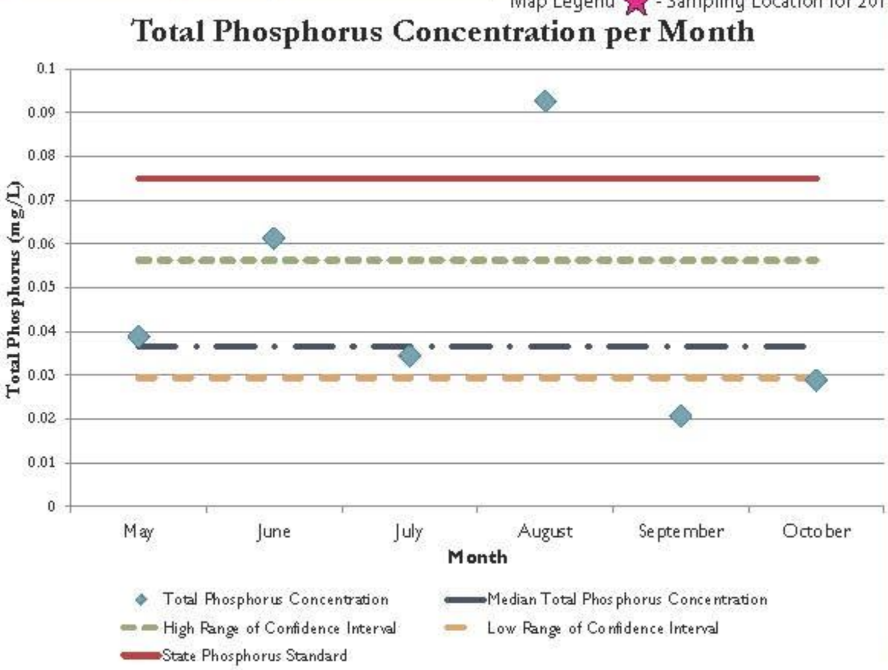
Greg Cleereman

TP Criteria Met

Monitoring Site Quick Facts	
SWIMS Station ID	10042807
WBIC	516000
County	Marinette
Watershed	Lower Peshtigo River
Watershed Area	194.98 sq miles
Total Stream Miles	281.45
Downstream Waterbody	Trout Creek

2015 Monitoring Results	
Minimum TP Value	0.0207 mg/L
Maximum TP Value	0.0926 mg/L
Median TP Value	0.0365 mg/L
No. Samples > 0.075mg/L	1

Map Legend ★ - Sampling Location for 2015



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Water Action Volunteers

2015 Total Phosphorus Monitoring Program

Trout Creek - Poplar Ridge Road N of CTH B

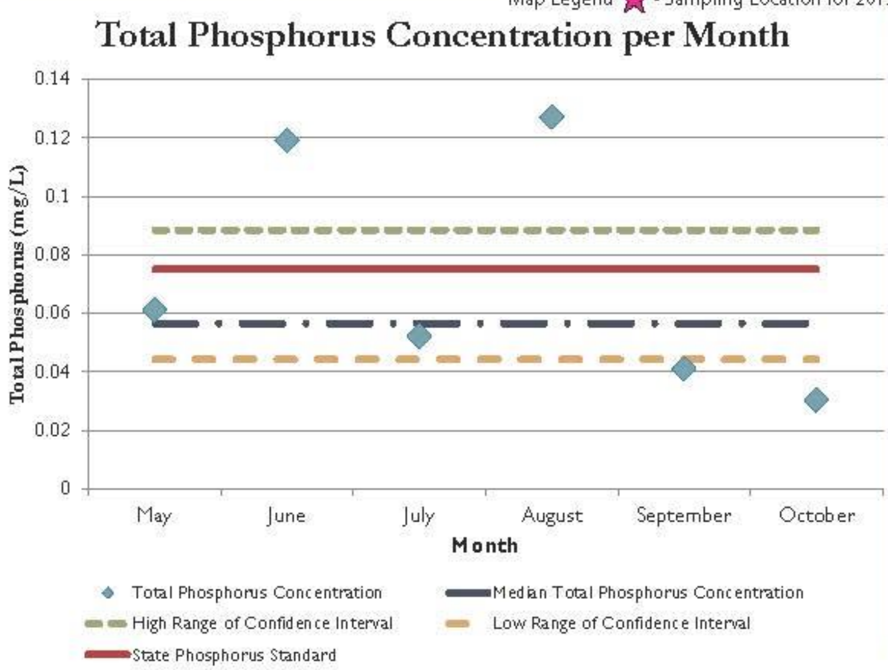
Watch Waters

Greg Cleereman

Monitoring Site Quick Facts	
SWIMS Station ID	10016931
WBIC	515900
County	Marinette
Watershed	Lower Peshtigo River
Watershed Area	194.98 sq miles
Total Stream Miles	281.45
Downstream Waterbody	Peshtigo River

2015 Monitoring Results	
Minimum TP Value	0.0303 mg/L
Maximum TP Value	0.127 mg/L
Median TP Value	0.056 mg/L
No. Samples > 0.075mg/L	2

Map Legend ★ - Sampling Location for 2015



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Water Action Volunteers

2015 Total Phosphorus Monitoring Program

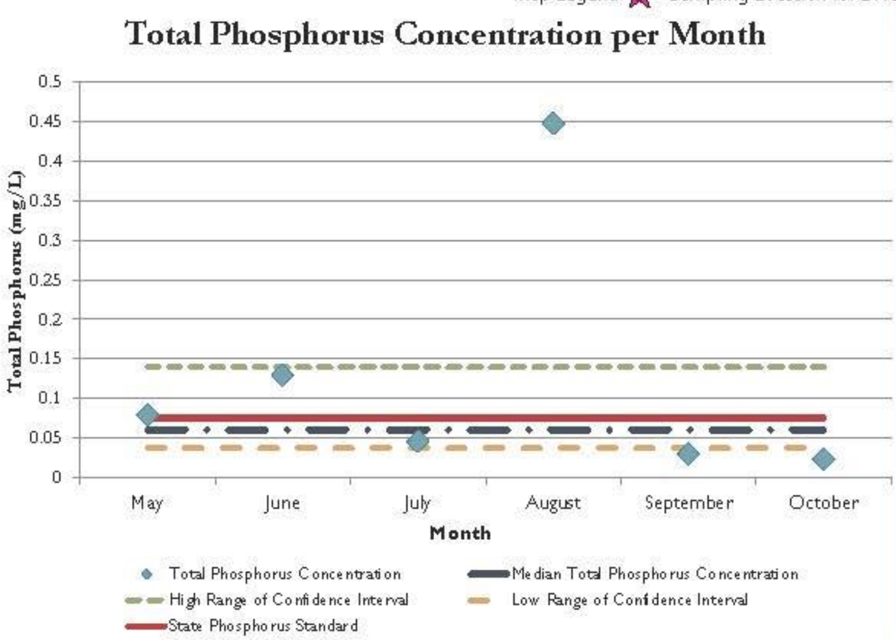
Trout Creek US at Jandt Road

Watch Waters

Greg Cleereman

Monitoring Site Quick Facts	
SWIMS Station ID	10043555
WBIC	515900
County	Marinette
Watershed	Lower Peshtigo River
Watershed Area	194.98 sq miles
Total Stream Miles	281.45
Downstream Waterbody	Lower Peshtigo River
2015 Monitoring Results	
Minimum TP Value	0.0225 mg/L
Maximum TP Value	0.448 mg/L
Median TP Value	0.060 mg/L
No. Samples > 0.075mg/L	3

Map Legend ★ - Sampling Location for 2015



As part of this project, Water Action Volunteers stream monitors collected water samples in streams in the Lower Peshtigo River watershed in Marinette and Oconto Counties. Basin assessment monitoring was recommended in historic watershed plan recommendations, but has never been conducted. Marinette County is seeking to develop a 9-Key Element plan for a HUC-12 sub-watershed or the entire Lower Peshtigo River watershed. This monitoring will help support and guide the development of the 9-Key Element plan by gathering baseline data and eliminating data gaps.

Water Action Volunteers
2015 Total Phosphorus Monitoring Program
Unnamed Trib to Peshtigo River at River Road

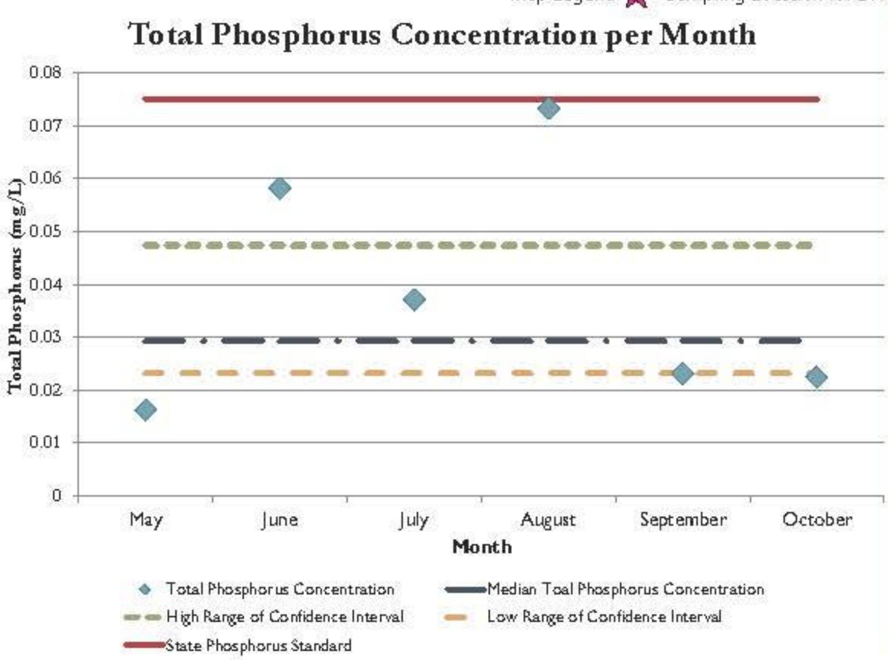
TP Criteria Met

Greg Cleereman

Monitoring Site Quick Facts	
SWIMS Station ID	10042936
WBIC	5008962
County	Marinette
Watershed	Lower Peshtigo River
Watershed Area	194.98 sq miles
Total Stream Miles	281.45
Downstream Waterbody	Peshtigo River

2015 Monitoring Results	
Minimum TP Value	0.0162 mg/L
Maximum TP Value	0.0733 mg/L
Median TP Value	0.0293 mg/L
No. Samples > 0.075mg/L	0

Map Legend ★ - Sampling Location for 2015



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Water Action Volunteers

2015 Total Phosphorus Monitoring Program

UNT to Peshtigo River at CTH B

Greg Cleereman

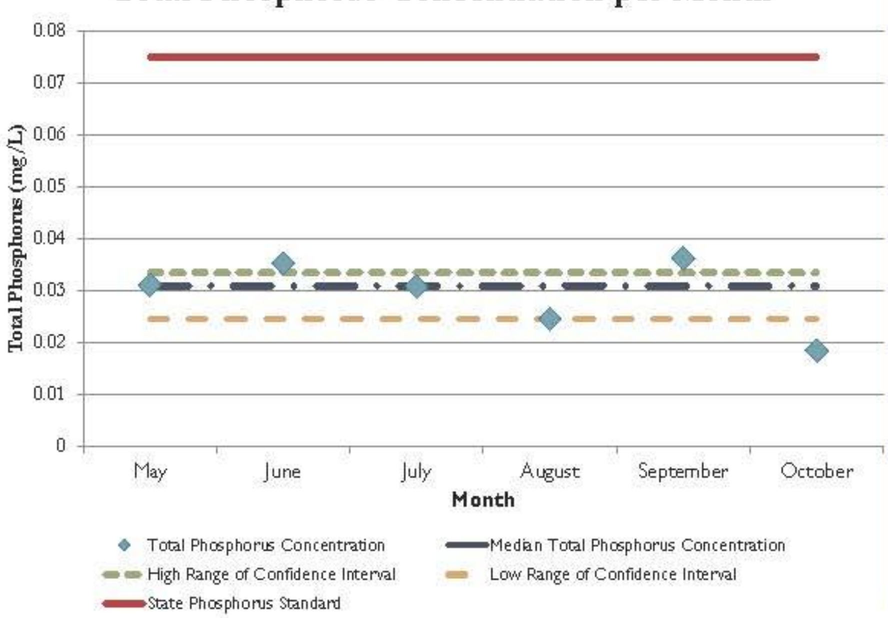
TP Criteria Met

Monitoring Site Quick Facts	
SWIMS Station ID	10042825
WBIC	5008966
County	Marinette
Watershed	Lower Peshtigo
Watershed Area	194.98 sq miles
Total Stream Miles	281.45
Downstream Waterbody	Peshtigo River

2015 Monitoring Results	
Minimum TP Value	0.0184 mg/L
Maximum TP Value	0.0362 mg/L
Median TP Value	0.0309 mg/L
No. Samples > 0.075mg/L	0

Map Legend ★ - Sampling Location for 2015

Total Phosphorus Concentration per Month



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Water Action Volunteers

2015 Total Phosphorus Monitoring Program

UNT to Peshtigo River at CTH B

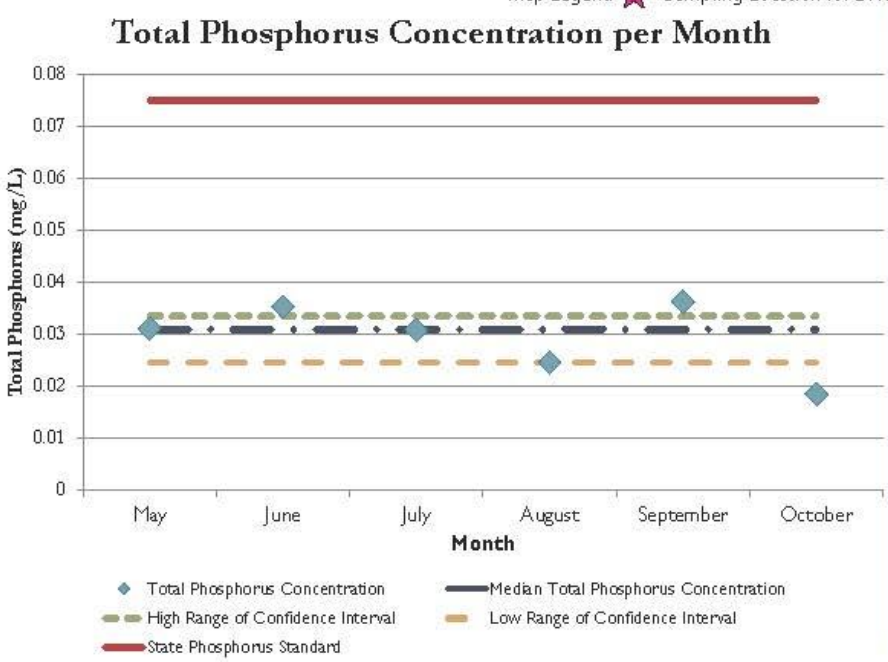
TP Criteria Met

Greg Cleereman

Monitoring Site Quick Facts	
SWIMS Station ID	10042825
WBIC	5008966
County	Marinette
Watershed	Lower Peshtigo
Watershed Area	194.98 sq miles
Total Stream Miles	281.45
Downstream Waterbody	Peshtigo River

2015 Monitoring Results	
Minimum TP Value	0.0184 mg/L
Maximum TP Value	0.0362 mg/L
Median TP Value	0.0309 mg/L
No. Samples > 0.075mg/L	0

Map Legend ★ - Sampling Location for 2015



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Water Action Volunteers

2015 Total Phosphorus Monitoring Program

UNT to Peshtigo River on CTY BB

TP Criteria Met

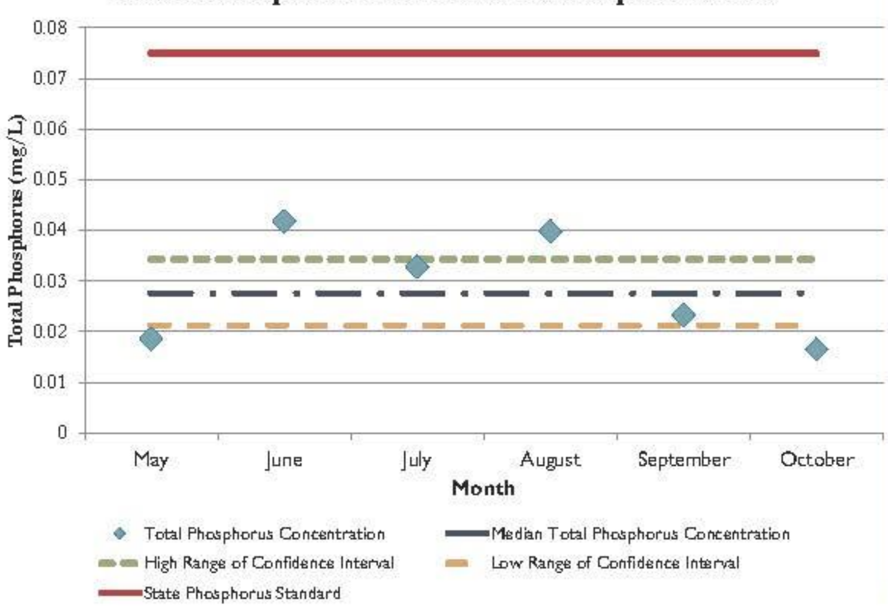
Greg Cleereman

Monitoring Site Quick Facts	
SWIMS Station ID	10042808
WBIC	515600
County	Marinette
Watershed	Lower Peshtigo
Watershed Area	194.98 sq miles
Total Stream Miles	281.45
Downstream Waterbody	Peshtigo River

2015 Monitoring Results	
Minimum TP Value	0.0165 mg/L
Maximum TP Value	0.0418 mg/L
Median TP Value	0.0276 mg/L
No. Samples > 0.075mg/L	0

Map Legend ★ - Sampling Location for 2015

Total Phosphorus Concentration per Month



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Appendix 2.

STEPL Pre and Post Project BMP Inputs								
	Pre-Project				Post-Project			
Watershed	# Months Manure Applied	% Area Combined BMPs Calculated	% Area Waste Mgmt. System	Feedlot % Paved	# Months Manure Applied	% Area Combined BMPs Calculated	% Area Waste Mgmt. System	Feedlot % Paved
Gravelly Brook	10	20	20	0-24%	6	70	75	75-100%
Little River Frontal	6	10	0	0-24%	6	70	90	75-100%
Peshtigo Dam	10	35	35	0-24%	6	70	90	75-100%
Peshtigo River Frontal	10	25	25	0-24%	6	70	90	75-100%
Potato Rapids	11	25	25	0-24%	6	70	75	75-100%
Thomas Slough	12	0	0	0-24%	6	0	0	0-24%
Trout Creek	8	60	60	0-24%	6	85	90	75-100%

STEPL Inputs for Pre and Post Project *Combined BMP's Calculated*							
Pre-Project		Pre-Project			Post-Project		
Watershed	Subwatershed Cropland Acres	% Area Combined BMPs Calculated	Acres Combined BMPs Calculated		% Area Combined BMPs Calculated	Acres Combined BMPs Calculated	Additional Acres with Combined BMP's Calculated
Gravelly Brook	2389	20%	477.8		70%	1672.3	1194.5
Little River Frontal	762	10%	76.2		70%	533.4	457.2
Peshtigo Dam	1680	35%	588		70%	1176	588
Peshtigo River Frontal	3194	25%	798.5		70%	2235.8	1437.3
Potato Rapids	3521	25%	880.25		70%	2464.7	1584.45
Thomas Slough	21545	0%	0		0%	0	0
Trout Creek	9468	60%	5680.8		85%	8047.8	2367
			8501.55			16130	7628.45
	Combined BMPs are Reduced Tillage and Nutrient Management Planning						

Appendix 3.

Technical Memorandum #1

Adjusting for Depreciation of Land Treatment When Planning Watershed Projects

United States Environmental Protection Agency

This Technical Memorandum is one of a series of publications designed to assist watershed projects, particularly those addressing nonpoint sources of pollution. Many of the lessons learned from the Clean Water Act Section 319 National Nonpoint Source Monitoring Program are incorporated in these publications.

October 2015

Donald W. Meals and Steven A. Dressing. 2015. Technical Memorandum #1: Adjusting for Depreciation of Land Treatment When Planning Watershed Projects, October 2015. Developed for U.S. Environmental Protection Agency by Tetra Tech, Inc., Fairfax, VA, 16 p.
Available online at www.epa.gov/xxx/tech_memos.htm.

Technical Memorandum #1

Adjusting for Depreciation of Land Treatment When Planning Watershed Projects

Introduction

Watershed-based planning helps address water quality problems in a holistic manner by fully assessing the potential contributing causes and sources of pollution, then prioritizing restoration and protection strategies to address the problems (USEPA 2013). The U.S. Environmental Protection Agency (EPA) requires that watershed projects funded directly under section 319 of the Clean Water Act implement a watershed-based plan (WBP) addressing the nine key elements identified in EPA's *Handbook for Developing Watershed Plans to Restore and Protect our Waters (USEPA 2008)*. EPA further recommends that all other watershed plans intended to address water quality impairments also include the nine elements. The first element calls for the identification of causes and sources of impairment that must be controlled to achieve needed load reductions. Related elements include a description of the nonpoint source (NPS) management measures—or best management practices (BMPs)—needed to achieve required pollutant load reductions, a description of the critical areas in which the BMPs should be implemented, and an estimate of the load reductions expected from the BMPs.

Fields near Seneca Lake, New York.

Once the causes and sources of water resource impairment are assessed, identifying the appropriate BMPs to address the identified problems, the best locations for additional BMPs, and the pollutant load reductions likely to be achieved with the BMPs depends on accurate information on the performance levels of both BMPs already in place and BMPs to be implemented as part of the watershed project. All too often, watershed managers and Agency staff have assumed that, once certified as installed or adopted according to specifications, a BMP continues to perform its pollutant reduction function at the same efficiency (percent pollutant reduction) throughout its design or contract life, sometimes longer. An important corollary to this assumption is that BMPs in place during project planning are performing as originally intended. Experience in NPS watershed projects across the nation, however, shows that, without diligent operation and maintenance, BMPs and their effects probably will depreciate over time, resulting in less efficient pollution reduction. Recognition of this fact is important at the project planning phase, for both existing and planned BMPs.

Knowledge of land treatment depreciation is important to ensure project success through the adaptive management process (USEPA 2008). BMPs credited during the planning phase of a watershed project will be expected to achieve specific load reductions or other water quality benefits as part of the overall plan to protect or restore a water body. Verification that BMPs are still performing their functions at anticipated levels is essential to keeping a project on track to achieve its overall goals. Through adaptive management, verification results can be used to inform decisions about needs for additional BMPs or maintenance or repair of existing BMPs. In a watershed project that includes short-term (3–5 years) monitoring, subtle changes in BMP performance level might not be detectable or critical, but planners must account for catastrophic failures, BMP removal or discontinuation, and major maintenance shortcomings. Over the longer term, however, gradual changes in BMP performance level can be significant in terms of BMP-specific pollutant control or the role of single BMPs within a BMP system or train. The weakest link in a BMP train can be the driving force in overall BMP performance.

> Application of and methods for BMP tracking in NPS watershed projects are described in detail in *Tech Notes 11* (Meals et al. 2014).

This technical memorandum addresses the major causes of land treatment depreciation, ways to assess the extent of depreciation, and options for adjusting for depreciation. While depreciation occurs throughout the life of a watershed project, the emphasis is on the planning phase and the short term (i.e., 3–5 years).

Causes of Depreciation

Depreciation of land treatment function occurs as a result of many factors and processes. Three of the primary causes are natural variability, lack of proper maintenance, and unforeseen consequences.

Natural Variability

Climate and soil variations across the nation influence how BMPs perform. Tiessen et al. (2010), for example, reported that management practices designed to improve water quality by reducing sediment and sediment-bound nutrient export from agricultural fields can be less effective in cold, dry regions where nutrient export is primarily snowmelt driven and in the dissolved form, compared to similar practices in warm, humid regions. Performance levels of vegetation-based BMPs in both agricultural and urban settings can vary significantly through the year due to seasonal dormancy. In a single locale, year-to-year variation in precipitation affects both agricultural management and BMP performance levels. Drought, for example, can suppress crop yields, reduce nutrient uptake, and result in nutrient surpluses left in the soil after harvest where they are vulnerable to runoff or leaching loss despite careful nutrient management. Increasing incidence of extreme weather and intense storms can overwhelm otherwise well-designed stormwater management facilities in urban areas.

Lack of Proper Maintenance

Most BMPs—both structural and management—must be operated and maintained properly to continue to function as designed. Otherwise, treatment effectiveness can depreciate over time. For example, in a properly functioning detention pond, sediment typically accumulates in the forebay. Without proper maintenance to remove accumulated sediment, the capacity of the BMP to contain and treat stormwater is diminished. Similarly, a nutrient management plan is only as effective as its implementation. Failure to adhere to phosphorus (P) application limits, for example, can result in soil P buildup and increased surface and subsurface losses of P rather than the loss reductions anticipated.

Jackson-Smith et al. (2010) reported that over 20 percent of implemented BMPs in a Utah watershed project appeared to be no longer maintained or in use when evaluated just 5 years after project completion. BMPs related to crop production enterprises and irrigation systems had the lowest rate of continued use and maintenance (~75 percent of implemented BMPs were still in use), followed by pasture and grazing planting and management BMPs (81 percent of implemented BMPs were still in use). Management practices (e.g., nutrient management) were found to be particularly susceptible to failure.

Practices are sometimes simply abandoned as a result of changes in landowner circumstances or attitudes. In a Kansas watershed project, farmers abandoned a nutrient management program because of perceived restrictive reporting requirements (Osmond et al. 2012).

Abandoned waste storage structure.

In the urban arena, a study of more than 250 stormwater facilities in Maryland found that nearly one-third of stormwater BMPs were not functioning as designed and that most needed maintenance (Lindsey et al. 1992). Sedimentation was a major problem and had occurred at nearly half of the facilities; those problems could have been prevented with timely maintenance.

Hunt and Lord (2006) describe basic maintenance requirements for bioretention practices and the consequences of failing to perform those tasks. For example, they indicate that mulch should be removed every 1–2 years to both maintain available water storage volume and increase the surface infiltration rate of fill soil. In addition, biological films might need to be removed every 2–3 years because they can cause the bioretention cell to clog.

In plot studies, Dillaha et al. (1986) observed that vegetative filter strip-effectiveness for sediment removal appeared to decrease with time as sediment accumulated within the filter strips. One set of the filters was almost totally inundated with sediment during the cropland experiments and filter effectiveness dropped 30–60 percent between the first and second experiments. Dosskey et al. (2002) reported that up to 99 percent of sediment was removed from cropland runoff when uniformly distributed over a buffer area, but as concentrated flow paths developed over time (due to lack of maintenance), sediment removal dropped to 15–45 percent. In the end, most structural BMPs have a design life (i.e., the length of time the item is expected to work within its specified parameters). This period is measured from when the BMP is placed into service until the end of its full pollutant reduction function.

Unforeseen Consequences

The effects of a BMP can change directly or indirectly due to unexpected interactions with site conditions or other activities. Incorporating manure into cropland soils to reduce nutrient runoff, for example, can increase erosion and soil loss due to soil disturbance, especially in comparison to reduced tillage. On the other hand, conservation tillage can result in accumulation of fertilizer nutrients at the soil surface, increasing their availability for loss in runoff (Rhoton et al. 1993). Long-term reduction in tillage also can promote the formation of soil macropores, enhancing leaching of soluble nutrients and agrichemicals into ground water (Shipitalo et al. 2000). Stutter et al. (2009) reported that establishment of vegetated buffers between cropland and a watercourse led to enhanced rates of soil P cycling within the buffer, increasing soil P solubility and the potential for leaching to watercourses.

Despite widespread adoption of conservation tillage and observed reductions in particulate P loads, a marked increase in loads of dissolved bioavailable P in agricultural tributaries to Lake Erie has been documented since the mid-1990s. This shift has been attributed to changes in application rates, methods, and timing of P fertilizers on cropland in conservation tillage not subject to annual tillage (Baker 2010; Joosse and Baker 2011). Further complicating matters, recent research on fields in the St. Joseph River watershed in northeast Indiana has demonstrated that about half of both soluble P and total P losses from research fields occurred via tile discharge, indicating a need to address both surface and subsurface loads to reach the goal of 41 percent reduction in P loading for the Lake Erie Basin (Smith et al. 2015).

Several important project planning lessons were learned from the White Clay Lake, Wisconsin, demonstration projects in the 1970s, including the need to accurately assess pollutant inputs and the performance levels of BMPs (NRC 1999). Regarding unforeseen consequences, the project learned through monitoring that a manure storage pit built according to prevailing specifications actually caused ground water contamination that threatened a farmer's well water. This illustrates the importance of monitoring implemented practices over time to ensure that they function properly and provide the intended benefits.

Control of urban stormwater runoff (e.g., through detention) has been widely implemented to reduce peak flows from large storms in order to prevent stream channel erosion. Research has shown, however, that although large peak flows might be controlled effectively by detention storage, stormflow conditions are extended over a longer period of time. Duration of erosive and bankfull flows are increased, constituting channel-forming events. Urbonas and Wulliman (2007) reported that, when captured runoff from a number of individual detention basins in a stream system is released over time, the flows accumulate as they travel downstream, actually increasing peak flows along the receiving waters. This situation can diminish the collective effectiveness of detention basins as a watershed management strategy.

Assessment of Depreciation

The first—and possibly most important—step in adjusting for depreciation of implemented BMPs is to determine its extent and magnitude through BMP verification.

BMP Verification

At its core, BMP verification confirms that a BMP is in place and functioning properly as expected based on contract, permit, or other implementation evidence. A BMP verification process that documents the presence and function of BMPs over time should be included in all NPS watershed projects.

At the project planning phase, verification is important both to ensure accurate assessment of existing BMP performance levels and to determine additional BMP and maintenance needs. Verification over time is necessary to determine if BMPs are maintained and operated during the period of interest.

Documenting the presence of a BMP is generally simpler than determining how well it functions, but both elements of verification must be considered to determine if land treatment goals are being met and whether BMP performance is depreciating. Although land treatment goals might not be highly specific in many watershed projects, it is important to document what treatment is implemented. Verification is described in detail in *Tech Notes 11* (Meals et al. 2014). This technical memorandum focuses on specific approaches to assessing depreciation within the context of an overall verification process.

Methods for Assessing BMP Presence and Performance Level

Whether a complete enumeration or a statistical sampling approach is used, methods for tracking BMPs generally include direct measurements (e.g., soil tests, onsite inspections, remote sensing) and indirect methods (e.g., landowner self-reporting or third-party surveys). Several of these methods are discussed in *Tech Notes 11* (Meals et al. 2014). Two general factors must be considered when verifying a BMP: the presence of the BMP and its pollutant removal efficiency. Different types of BMPs require different verification methods, and no single approach is likely to provide all the information needed in planning a watershed project.

Certification

The first step in the process is to determine whether BMPs have been designed and installed/adopted according to appropriate standards and specifications. Certification can either be the final step in a contract between a landowner and a funding agency or be a component of a permit requirement.

Certification provides assurance that a BMP is fully functional for its setting at a particular time. For example, a stormwater detention pond or water and sediment control basin must be properly sized for its contributing area and designed for a specific retention-and-release performance level. A nutrient management plan must account for all sources of nutrients, consider current soil nutrient levels, and support a reasonable yield goal. A cover crop must be planted in a particular time window to provide erosion control and/or nutrient uptake during a critical time of year. Some jurisdictions might apply different nutrient reduction efficiency credits for cover crops based on planting date. Some structural BMPs like parallel tile outlet terraces require up to 2 years to fully settle and achieve full efficiency; in those cases, certification is delayed until full stability is reached. Knowledge that a BMP has been applied according to a specific standard supports an assumption that the BMP will perform at a certain level of pollutant reduction efficiency, providing a baseline against which future depreciation can be compared. Practices voluntarily implemented by landowners without any technical or financial assistance could require special efforts to determine compliance with applicable specifications (or functional equivalence). Pollution reduction by practices not meeting specifications might need to be discounted or not counted at all even when first installed.

Depreciation assessment indicators

Ideally, assessment of BMP depreciation would be based on actual measurement of each BMP's performance level (e.g., monitoring of input and output pollutant loads for each practice). Except in very rare circumstances, this type of monitoring is impractical. Rather, a watershed project generally must depend on the use of indicators to assess BMP performance level.

The most useful indicators for assessing depreciation are determined primarily by the type of BMP and pollutants controlled, but indicators might be limited by the general verification approach used. For example, inflow and outflow measurements of pollutant load can be used to determine the effectiveness of constructed wetlands, but a verification effort that uses only visual observations will not provide that data or other information about wetland functionality. A central challenge, therefore, is to identify meaningful indicators of BMP performance level that can be tracked under different verification schemes. This technical memorandum provides examples of how to accomplish that end.

Nonvegetative structural practices

Performance levels of nonvegetative structural practices—such as animal waste lagoons, digesters, terraces, irrigation tailwater management, stormwater detention ponds, and pervious pavement—can be assessed using the following types of indicators:

- Measured on-site performance data (e.g., infiltration capacity of pervious pavement),
- Structural integrity (e.g., condition of berms or other containment structures), and
- Water volume capacity (e.g., existing pond volume vs. design) and mass or volume of captured material removed (e.g., sediment removed from stormwater pond forebay at cleanout).

In some cases, useful indicators can be identified directly from practice standards. For example, the Natural Resources Conservation Service lists operation and maintenance elements for a water and sediment control basin (WASCoB) (*USDA-NRCS 2008*) that include:

- Maintenance of basin ridge height and outlet elevations,
- Removal of sediment that has accumulated in the basin to maintain capacity and grade,
- Removal of sediment around inlets to ensure that the inlet remains the lowest spot in the basin, and
- Regular mowing and control of trees and brush.

These elements suggest that ridge and outlet elevations, sediment accumulation, inlet integrity, and vegetation control would be important indicators of WASCoB performance level.

Required maintenance checklists contained in stormwater permits also can suggest useful indicators. For example, the *Virginia Stormwater Management Handbook* (VA DCR 1999) provides an extensive checklist for annual operation and maintenance inspection of wet ponds. The list includes many elements that could serve as BMP performance level indicators:

- Excessive sediment, debris, or trash accumulated at inlet,
- Clogging of outlet structures,

- Cracking, erosion, or animal burrows in berms, and
- More than 1 foot of sediment accumulated in permanent pool.

Assessment of these and other indicators would require on-site inspection and/or measurement by landowners, permit-holders, or oversight agencies.

Vegetative structural practices

Performance levels of vegetative structural practices—such as constructed wetlands, swales, rain gardens, riparian buffers, and filter strips—can be assessed using the following types of indicators:

- Extent and health of vegetation (e.g., measurements of soil cover or plant density),
- Quality of overland flow filtering (e.g., evidence of short-circuiting by concentrated flow or gullies through buffers or filter strips),
- On-site capacity testing of rain gardens using infiltrometers or similar devices, and
- Visual observations (e.g., presence of water in swales and rain gardens).

Parking lot rain garden.

As for non-vegetative structural practices, assessment of these indicators would require on-site inspection and/or measurement by landowners, permit-holders, or oversight agencies.

Nonstructural vegetative practices

Performance levels of nonstructural vegetative practices—such as cover crops, reforestation of logged tracts, and construction site seeding—can be assessed using the following types of indicators:

- Density of cover crop planting (e.g., plant count),
- Percent of area covered by cover crop, and
- Extent and vitality of tree seedlings.

These indicators could be assessed by on-site inspection or, in some cases, by remote sensing, either from satellite imagery or aerial photography.

Management practices

Performance levels of management practices—such as nutrient management, conservation tillage, pesticide management, and street sweeping—can be assessed using the following types of indicators:

- Records of street sweeping frequency and mass of material collected,
- Area or percent of cropland under conservation tillage,

- Extent of crop residue coverage on conservation tillage cropland, and
- Fertilizer and/or manure application rates and schedules, crop yields, soil test data, plant tissue test results, and fall residual nitrate tests.

Illustration of line-transect method for residue.

Assessment of these indicators would generally require reporting by private landowners or municipalities, reporting that is required under some regulatory programs. Visual observation of indicators such as residue cover, however, can also be made by on-site inspection or windshield survey.

Data analysis

Data on indicators can be expressed and analyzed in several ways, depending on the nature of the indicators used. Indicators reporting continuous numerical data—such as acres of cover crop or conservation tillage, manure application rates, miles of street sweeping, mass of material removed from catch basins or detention ponds, or acres of logging roads/landings revegetated—can be expressed either in the raw form (e.g., acres with 30 percent or more residue cover) or as a percentage of the design or target quantity (e.g., percent of contracted acres achieving 30 percent or more of residue cover). These metrics can be tracked year to year as a measure of BMP depreciation (or achievement). During the planning phase of a watershed project, it might be appropriate to collect indicator data for multiple years prior to project startup to enable calculation of averages or ranges to better estimate BMP performance levels over crop rotation cycles or variable weather conditions.

Indicators reporting categorical data—such as maintenance of detention basin ridge height and outlet elevations, condition of berms or terraces, or observations of water accumulation and flow—are more difficult to express quantitatively. It might be necessary to establish an ordinal scale (e.g., condition rated on a scale of 1–10) or a binary yes/no condition, then use best professional judgment to assess influence on BMP performance.

In some cases, it might be possible to use modeling or other quantitative analysis to estimate individual or watershed-level BMP performance levels based on verification data. In an analysis of stormwater BMP performance levels, Tetra Tech (2010) presented a series of BMP performance curves based on monitoring and modeling data that relate pollutant removal efficiency to depth of runoff treated (Figure 1). Where depreciation indicators track changes in depth of runoff treated as the capacity of a BMP decreases (e.g., from sedimentation), resulting changes in pollutant removal could be determined from a performance curve. This type of information can be particularly useful during the planning phase of a watershed project to estimate realistic performance levels for existing BMPs that have been in place for a substantial portion of their expected lifespans.

The performance levels of structural agricultural BMPs in varying condition can be estimated by altering input parameters in the *Soil and Water Assessment Tool* (SWAT) model (Texas A&M University 2015a); other models such as the *Agricultural Policy/Environmental eXtender* (APEX) model (Texas A&M

University 2015b) also can be used in this way (including application to some urban BMPs). For urban stormwater, engineering models like [HydroCAD]() (HydroCAD Software Solutions 2011) can be used to simulate hydrologic response to stormwater BMPs with different physical characteristics (e.g., to compare performance levels under actual vs. design conditions). Even simple spreadsheet models such as the Spreadsheet Tool for Estimating Pollutant Load ([STEPL]()) (USEPA 2015) can be used to quantify the effects of BMP depreciation by varying the effectiveness coefficients in the model.

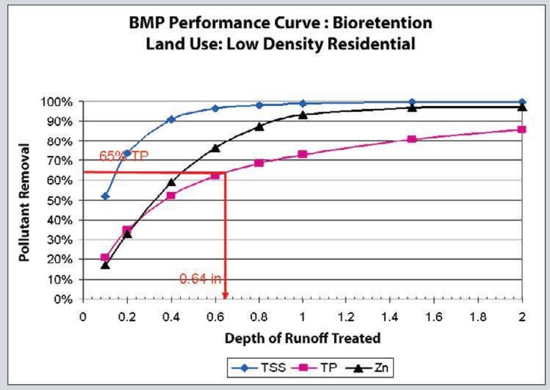

Figure 1. BMP Performance Curve for Bioretention BMP (Tetra Tech 2010).

Data from verification efforts and analysis of the effects of depreciation on BMP performance levels must be qualified based on data confidence. "Confidence" refers mainly to a quantitative assessment of the accuracy of a verification result. For example, the number of acres of cover crops or the continuity of streamside buffers on logging sites determined from aerial photography could be determined by ground-truthing to be within +10 percent of the true value at the 95 percent confidence level. Confidence also can refer to the level of trust that BMPs previously implemented continue to function (e.g., the proportion of BMPs still in place and meeting performance standards). For example, reporting that 75 percent of planned BMPs have been verified is a measure of confidence that the desired level of treatment has been applied.

While specific methods to evaluate data confidence are beyond the scope of this memo, it is essential to be able to express some degree of confidence in verification results—both during the planning phase and over time as the project is implemented. For example, an assessment of relative uncertainty of BMP performance during the planning phase can be used as direct follow-up to verification efforts to those practices for which greater quantification of performance level is needed. In addition, plans to implement new BMPs also can be developed with full consideration of the reliability of BMPs already in place.

Adjusting for Depreciation

Information on BMP depreciation can be used to improve both project management and project evaluation.

Project Planning and Management

Establishing baseline conditions

Baseline conditions of pollutant loading include not only pollutant source activity but also the influence of BMPs already in place at the start of the project. Adjustments based on knowledge of BMP depreciation can provide a more realistic estimate of baseline pollutant loads than assuming that existing land treatment has reduced NPS pollutant loads by some standard efficiency value.

Establishing an accurate starting point will make load reduction targets—and, therefore, land treatment design—more accurate. Selecting appropriate BMPs, identifying critical source areas, and prioritizing land treatment sites will all benefit from an accurate assessment of baseline conditions. Knowledge of depreciation of existing BMPs can be factored into models used for project planning (e.g., by adjusting pollutant removal efficiencies), resulting in improved understanding of overall baseline NPS loads and their sources.

While not a depreciation issue per se, when a BMP is first installed—especially a vegetative BMP like a buffer or filter strip—it usually takes a certain amount of time before its pollutant reduction capacity is fully realized. For example, Dosskey et al. (2007) reported that the nutrient reduction performance of newly established vegetated filter strips increased over the first 3 years as dense stands of vegetation grew in and soil infiltration improved; thereafter, performance level was stable over a decade. When planning a watershed project, vegetative practices should be examined to determine the proper level of effectiveness to assume based on growth stage. Also, because of weather or management conditions, some practices (e.g., trees) might take longer to reach their full effectiveness or might never reach it. The Stroud Preserve, Pennsylvania, section 319 National Nonpoint Source Monitoring Program (NNPSMP) project (1992–2007) found that slow tree growth in a newly established riparian forest buffer delayed significant NO_3–N (nitrate) removal from ground water until about 10 years after the trees were planted (Newbold et al. 2008).

The performance of practices can change in multiple ways over time. For example, excessive deposition in a detention pond that is not properly maintained could reduce overall percent removal of sediment because of reduced capacity as illustrated in Figure 1. The relative and absolute removal efficiencies for various particle size fractions (and associated pollutants) also can change due to reduced hydraulic retention time. Fine particles generally require longer settling times than larger particles, so removal efficiency of fine particles (e.g., silt, clay) can be disproportionally reduced as a detention pond or similar BMP fills with sediment and retention time deteriorates. Expert assessment of the condition and likely current performance level of existing BMPs, particularly those for which a significant amount of pollutant removal is assumed, is essential to establishing an accurate baseline for project planning.

Adaptive watershed management

Watershed planning and management is an iterative process; project goals might not all be fully met during the first project cycle and management efforts usually need to be adjusted in light of ongoing changes. In many cases, several cycles—including mid-course corrections—might be needed for a project to achieve its goals. Consequently, EPA recommends that watershed projects pursue a dynamic and adaptive approach so that implementation of a watershed plan can proceed and be modified as new information becomes available (USEPA 2008). Measures of BMP implementation commonly used as part of progress assessment should be augmented with indicators of BMP depreciation. Combining this information with other relevant project data can provide reliable progress assessments that will indicate gaps and weaknesses that need to be addressed to achieve project goals.

BMP design and delivery system

Patterns in BMP depreciation might yield information on systematic failures in BMP design or management that can be addressed through changes to standards and specifications, contract terms, or permit requirements. This information could be particularly helpful during the project planning phase when both the BMPs and their implementation mechanisms are being considered. For example, a cost-sharing schedule that has traditionally provided all or most funding upon initial installation of a BMP could be adjusted to distribute a portion of the funds over time if operation and maintenance are determined to be a significant issue based on pre-project information. Some BMP components, on the other hand, might need to be dropped or changed to make them more appealing to or easier to manage by landowners. Within the context of a permit program, for example, corrective actions reports might indicate specific changes that should be made to BMPs to ensure their proper performance.

Project Evaluation

Monitoring

Although short-term (3–5 year) NPS watershed projects will not usually have a sufficiently long data record to evaluate incremental project effects, data on BMP depreciation might still improve interpretation of collected water quality data. Even in the short term, water quality monitoring data might reflect cases in which BMPs have suffered catastrophic failures (e.g., an animal waste lagoon breach), been abandoned, or been maintained poorly. Meals (2001), for example, was able to interpret unexpected spikes in stream P and suspended sediment concentrations by walking the watershed and discovering that a landowner had over-applied manure and plowed soil directly into the stream.

Longer-term efforts (e.g., total maximum daily loads[1]) might engage in sustained monitoring beyond individual watershed project lifetime(s). The extended monitoring period will generally allow detection of more subtle water quality impacts for which interpretation could be enhanced with information on BMP depreciation. While not designed as BMP depreciation studies, the following two examples illustrate how changes in BMP performance can be related to water quality.

In a New York dairy watershed treated with multiple BMPs, Lewis and Makarewicz (2009) reported that the suspension of a ban on winter manure application 3 years into the monitoring study led to dramatic increases in stream nitrogen and phosphorus concentrations. First and foremost, knowledge of that suspension provided a reasonable explanation for the observed increase in nutrient levels. Secondly, the study was able to use data from the documented depreciation of land treatment to determine that the winter spreading ban had yielded 60–75 percent reductions in average stream nutrient concentrations.

The Walnut Creek, Iowa, Section 319 NNPSMP project promoted conversion of row crop land to native prairie to reduce stream NO_3-N levels and used simple linear regression to show association of two monitored variables: tracked conversion of row crop land to restored prairie vegetation and stream NO_3-N concentrations (Schilling and Spooner 2006). Because some of the restored prairie was plowed back into cropland during the project period—and because that change was

[1] "Total maximum daily loads" as defined in §303(d) of the Clean Water Act.

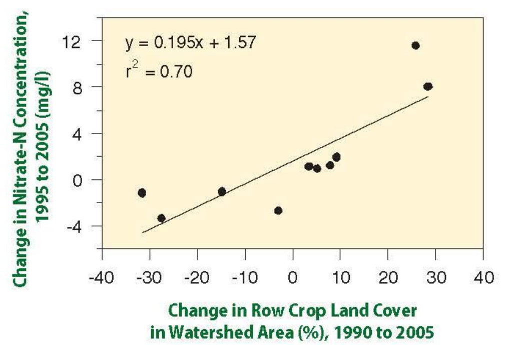

Figure 2. Relating Changes in Stream Nitrate Concentrations to Changes in Row Crop Land Cover in Walnut Creek, Iowa (Schilling and Spooner 2006)).

documented—the project was able to show not only that converting crop land to prairie reduced stream NO_3-N concentrations but also that increasing row crop land led to increased NO_3-N levels (Figure 2).

Modeling

When watershed management projects are guided or supported by modeling, knowledge of BMP depreciation should be part of model inputs and parameterization.

The magnitude of implementation (e.g., acres of treatment) and the spatial distribution of both annual and structural BMPs should be part of model input and should not be static parameters. Where BMPs are represented by pollutant reduction efficiencies, those percentages can be adjusted based on verification of land treatment performance levels in the watershed. Incorporating BMP depreciation factors into models might require setting up a tiered approach for BMP efficiencies (e.g., different efficiency values for BMPs determined to be in fair, good, or excellent condition) rather than the currently common practice of setting a single efficiency value for a practice assumed to exist. This approach could be particularly important for management practices such as agricultural nutrient management or street sweeping, in which degree of treatment is highly variable. For structural practices, a depreciation schedule could be incorporated into the project, similar to depreciating business assets. In the planning phase of a watershed project, multiple scenarios could be modeled to reflect the potential range of performance levels for BMPs already in place.

Recommendations

The importance of having accurate information on BMP depreciation varies across projects and during the timeline of a single project. During the project planning phase, when plans for the achievement of pollutant reduction targets rely heavily on existing BMPs, it is essential to obtain good information on the level of performance of the BMPs to ensure that plan development is properly informed. If existing BMPs are a trivial part of the overall watershed plan, knowledge of BMP depreciation might not be critical during planning. As projects move forward, however, the types of BMPs implemented, their relative costs and contributions to achievement of project pollutant reduction goals, and the likelihood that BMP depreciation will occur during the period of interest will largely determine the type and extent of BMP verification required over time. The following recommendations should be considered within this context:

- For improved characterization of overall baseline NPS loads, better identification of critical source areas, and more effective prioritization of new land treatment during project planning, collect accurate and complete information about:
  - Land use,

  - Land management, and
  - The implementation and operation of existing BMPs. This information should include:
    - Original BMP installation dates,
    - Design specifications of individual BMPs,
    - Data on BMP performance levels if available, and
    - The spatial distribution of BMPs across the watershed.
- Track the factors that influence BMP depreciation in the watershed, including:
  - Variations in weather that influence BMP performance levels,
  - Changes in land use, land ownership, and land management,
  - Inspection and enforcement activities on permitted practices, and
  - Operation, maintenance, and management of implemented practices.
- Develop and use observable indicators of BMP status/performance that:
  - Are tailored to the set of BMPs implemented in the watershed and practical within the scope of the watershed project's resources,
  - Can be quantified or scaled to document the extent and magnitude of treatment depreciation, and
  - Are able to be paired with water quality monitoring data.
- After the implementation phase of the NPS project, conduct verification activities to document the continued existence and function of implemented practices to assess the magnitude of depreciation and provide a basis for corrective action. The verification program should:
  - Identify and locate all BMPs of interest, including cost-shared, non-cost-shared, required, and voluntary practices;
  - Capture information on structural, annual, and management BMPs;
  - Obtain data on BMP operation and maintenance activities; and
  - Include assessment of data accuracy and confidence.
- To adjust for depreciation of land treatment, apply verification data to watershed project management and evaluation by:
  - Applying results directly to permit compliance programs,
  - Relating documented changes in land treatment performance levels to observed water quality,
  - Incorporating measures of depreciated BMP effectiveness into modeling efforts, and
  - Using knowledge of treatment depreciation to correct problems and target additional practices as necessary to meet project goals in an adaptive watershed management approach.

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